621.305
ELE
Engng

April 25 cents

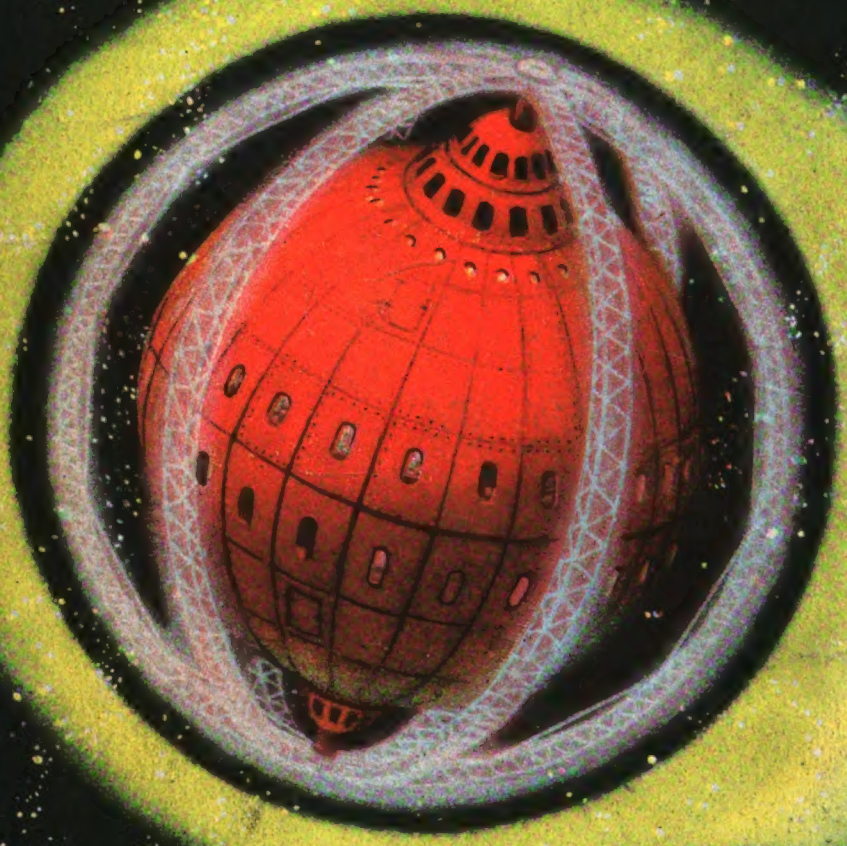
Science and Invention

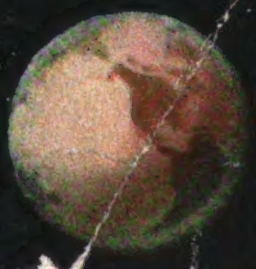
FORMERLY

ELECTRICAL EXPERIMENTER

CAN WE VISIT THE PLANETS?

See Page 1290

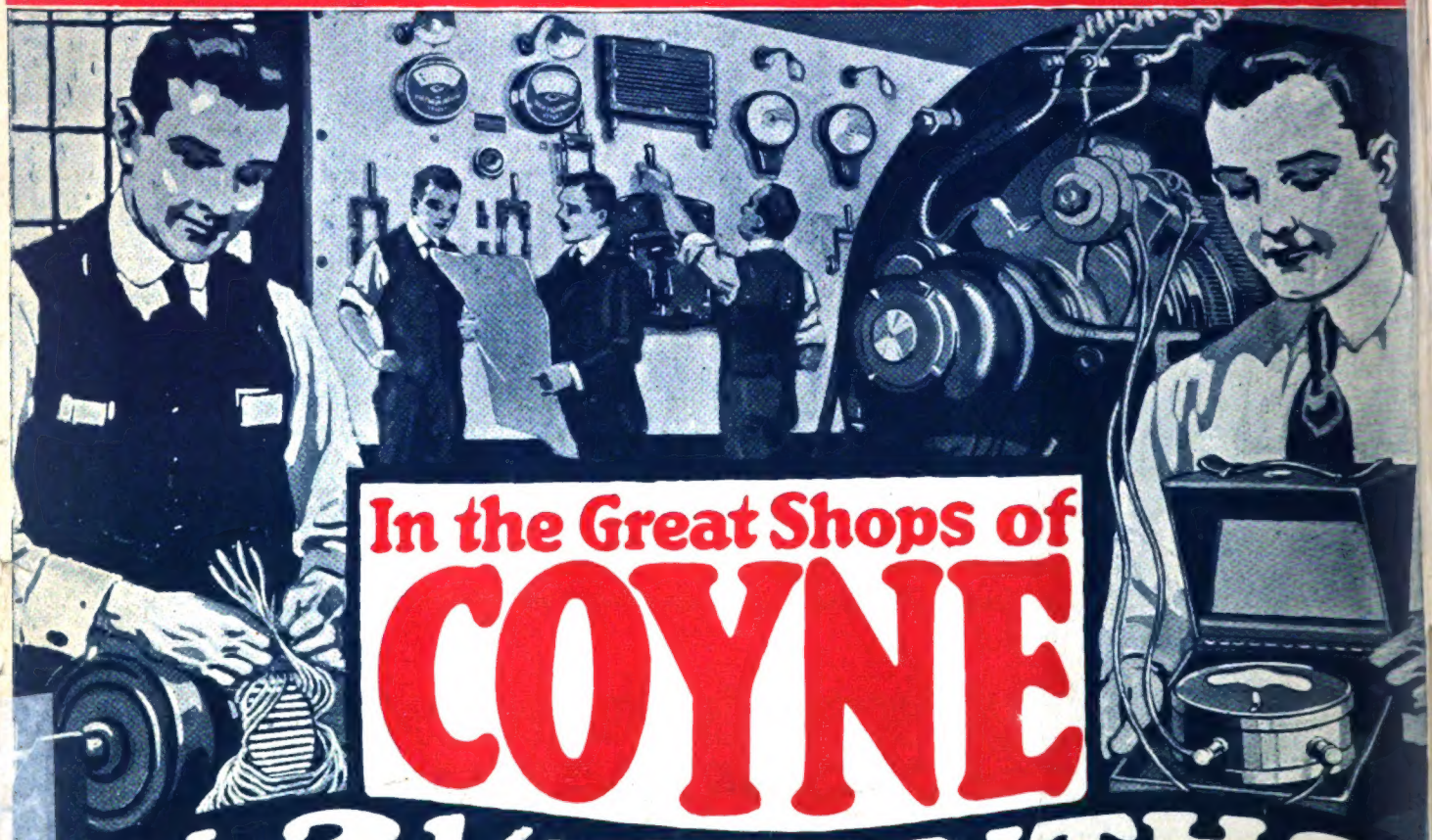




HOWARD BROWN

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Learn Electricity



In the Great Shops of COYNE

IN 3½ MONTHS

Hundreds of our graduates are making big money as Power Plant Operators, Electrical Engineers, Telephone Men, Superintendents, Electro Auto Engineers, etc. Hundreds of others are in the electrical contracting business for themselves and making from $3,000 to $20,000 a year. I want you to drop your present line and come to Coyne now and let us prepare you for big opportunities. MAIL COUPON—NOW.

EARN $65 TO $175 A WEEK

Your future lies in the Electrical Field. You like the work—it's a man game. Decide to enter now when the industry is growing faster than ever before and the demand for trained men vastly exceeds the supply—when BILLIONS are being invested in Electrical improvements and the certainty of your assured success is greater than ever before. You don't need much money. ACT NOW—Send coupon for big free Catalog and prepare to come at once to Coyne—America's Greatest Electrical School, where you will be trained at least expense by the best and quickest method of instruction—the "Learn by Doing" system perfected by us in 21 years of success.

Come With Us for 3½ Months

Our system assures your success in this study. In 98 days we have fitted thousands to make a smashing success. Now we want you to come—for the demand for practically trained men was NEVER so large.

We beat the world at turning out PRACTICALLY TRAINED ELECTRICIANS in quick time at small cost. We'll fit you in 98 days (stay longer if you wish ABSOLUTELY FREE of charge) to do all kinds of electrical work—from the simplest bell mechanism to the mighty motor and Electric Locomotive—and turn you out an all-around man ready to accept a fine position.

Simplest Instruction Known

You don't need to take one to four years to get your training. Neither do you need previous experience. For we use no books, have no classes and do not teach by correspondence. Electrical experts stand beside you to guide and instruct you while you do the actual work with your own hands, just exactly as you will later do it when you graduate with your diploma as Master Electrician.

Earn While You Learn

MAKE YOUR EXPENSES IN CHICAGO. Don't wait to save a lot of money. We have an employment manager whose sole business is to secure PART TIME jobs for students who need some extra help to meet their expenses. Hundrds of our students have worked their way through school and you can do the same. This is a most wonderful opportunity for you to secure the finest kind of Practical Electrical Training under circumstances that place it within the reach of any ambitious man.

Automotive Electricity FREE

We are able for a limited period to make you this astonishing offer—a course in Automotive Electrical Engineering—FREE. We have just greatly enlarged and newly equipped our Automotive Department with thousands of dollars worth of the latest apparatus, and can give the finest training in America on batteries, ignition, lighting and starting systems, as used on autos, trucks, tractors, etc. To those enrolling in our complete electrical course now, we offer you this entire automotive electricity course FREE. The cost of this training would cost you elsewhere more than we charge for our entire course. Act on this offer NOW. If we hear from you at once, we will reserve a course for you without charge.

SEND TODAY FOR BIG FREE BOOK

Write today, now, for the book. It tells what Coyne graduates have done—what you can do. Fill in the coupon and send it by the first mail. Don't wait a minute.

ACT NOW!

MAIL COUPON—OR WRITE—FOR FREE CATALOG—RIGHT NOW

BENNETT W. COOKE, *President*

COYNE TRADE AND ENGINEERING SCHOOLS

Dept. 24 39-51 E. Illinois St., Chicago, Ill.

COYNE TRADE AND ENGINEERING SCHOOLS

Bennett W. Cooke, President

Dept. 24, 39-51 E. Illinois St., Chicago, Ill.

Please send at once your big Catalog—and particulars of your free course in Automotive Electricity, fully prepaid and without obligation.

Name.....

Address.....

MAIL COUPON FOR FREE BOOK NOW

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Vol. VIII
Whole No. 96

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

April, 1921
No. 12

Publisht by Experimenter Publishing Company, Inc., (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y) 233 and 236 Fulton Street, New York

Scientific Paradoxes

THE more we learn, the less we know—is a true saying, particularly true today. Every new discovery, every new fact opens new labyrinths to our knowledge, without end to the number to be entered in the future. Take for instance light and heat, i. e., radiant energy as originated in our sun. When on a hot summer's day we sit in a broiling sun, out steps an aviator from his airplane. He is swathed in furs and wears an electrically heated suit. His face and fingers are not thawed out yet, due to the terrific cold he experienced only four miles above your head, ten minutes ago. Your thermometer registered 120 degrees in the sun, his 30 degrees below zero in the same sun! And he was actually four miles nearer to the sun than you. Of course science tells us the reason for this paradox. The dense atmosphere charged with watery vapor and perhaps with clouds near the earth, along with the solid and liquid matter of the earth's surface, easily retains and accumulates the heat received from the sun's rays. But four miles up the air is very rarefied and very diathermic, and the heat is no longer retained but passes through to mother earth with little effects on the thin atmosphere. Heat and the earth's atmosphere in this instance act analogously to water and a sponge. Water (heat) is eagerly absorbed by the sponge (atmosphere) and is retained by the latter. Now take the same size sponge which has big holes all thru it (rarefied atmosphere). It is evident that such a sponge cannot retain as much water as a perfect one. The more water you pour in it, the quicker it runs out.

But let us go a bit further. We actually know that all heavenly bodies gravitate in a perfect vacuum. Thus we know that if we were to rise only 500 miles above the surface of the earth, we would find ourselves in an absolute vacuum. We furthermore know that out in space the temperature in this vacuum is −459.4 degrees, i. e., absolute zero. We can also demonstrate by experiment that heat cannot be propagated in a vacuum by conduction or by convection. An ordinary thermos bottle readily proves this. Fill the latter with boiling water, and the outside will stay cold, due to the vacuum separating the inside and the outside of the bottle.

The case of the sun and the earth is analogous. Heat proper cannot flow between these bodies immersed in a perfect vacuum and besides separated some 92 million miles. So we see that we *do not* and cannot receive radiant heat rays from the sun.

Paradoxically enough we know for sure that we get heat *somehow* in spite of our logic. How? Scientists have a vague notion about it, but they are not too sure. They now think that when the ether waves, devoid of all temperature coming from the sun at a speed of 186,000 miles a second strike our dense atmosphere, the terrific impact results in heat; it is analogous to a meteor, which at a temperature of absolute zero, striking our atmosphere, goes up in metal vapor, due to the enormous friction set up. So we see that after all we do not get heat from the sun at all, merely ether waves, which by shock or impact are turned into heat.

Another paradox not so readily explained is the revolution of the earth around the sun. The earth with the sun at its center swings around the latter at the frightful speed of over 65,000 miles an hour. One would think that the titanic centrifugal force set up would make the earth fly off its orbit into infinite space. It can even be calculated that in order to keep the earth from being whipt off we would require a steel cable fastened to it and reaching to the sun. The thickness of this cable would have to be almost as great as the diameter of the earth! But there is no cable as we know and the earth does not fly out of its orbit. We talk merrily about mutual gravitation holding the earth to its course, but there are many objections, logical and otherwise. The plain truth is, we don't know.

H. GERNSBACK.

CONTENTS FOR APRIL, 1921

CAN WE VISIT THE PLANETS?.....Front Cover
From a Painting by Harold V. Brown
200-MILE-PER-HOUR AIR-PROPELLED RAILWAY..... 1279
ELECTRIC POWER FROM THE AIR..... 1280
SCIENTIFIC LIFTING STUNTS FOR YOUR PARLOR..... 1281
TYPEWRITING AND STENOGRAPHIC MACHINES FOR THE BLIND..... 1282
ODDITIES OF PHYSICS.....By H. Winfield Secor 1284
HOW BIG ARE MOLECULES?....By Rogers D. Rusk, M.A. 1286
PECULIAR BEETLE LOCOMOTION.....By Dr. E. Bade 1288
FLYING IN SPACE.....By H. Gernsback 1290
MOTOR HINTS PRIZE CONTEST..... 1293
POPULAR ASTRONOMY—THE ORIGIN OF THE EARTH 1294
By Isabel M. Lewis, M.A., of the U.S. Naval Observatory
HOW ROCKS GROW.....By William M. Butterfield 1297
THE "LOVE MACHINE"—SCIENTIFIC FICTION..... 1300
By Charles S. Wolfe
"IN 1999"—SCIENTIFIC FICTION....By B. Franklin Ruth 1302
A TRIP TO THE MOON..... 1303
RECENT WORK OF THE BUREAU OF STANDARDS..... 1305
HOME ELECTRICS—"WHEN THE FUSE BLOWS OUT".. 1306
By G. L. Hoadley, M.E.
HOME MECHANICS....Conducted by William M. Butterfield 1307
EXPERIMENTAL CHEMISTRY..By Prof. Floyd L. Darrow 1308
A MODEL ELECTRIC RAILWAY DE LUXE..... 1309
By Earl Christmas
IS OHM'S LAW VALID?.....By C. A. Briggs 1312
RADIO "TALK" RELAYED TO LAND LINES..... 1315
THE AUDIO-FREQUENCY AMPLIFIER IN FRANCE.... 1317
By Robert E. Lacault
"LATEST PATENTS" DIGEST..... 1319
WHAT TO INVENT.....By Jay G. Hobson 1320

SCIENCE AND INVENTION is publisht on the 25th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $3.00 a year in U. S. and possessions. Canada and foreign countries $3.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addrest to: Editor, SCIENCE AND INVENTION, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

SCIENCE AND INVENTION. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1921, by E. P. Co., Inc., New York. The Contents of this Magazine are copyrighted and must not be reproduced without giving full credit to the publication.

SCIENCE AND INVENTION is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Member of the Audit Bureau of Circulation.

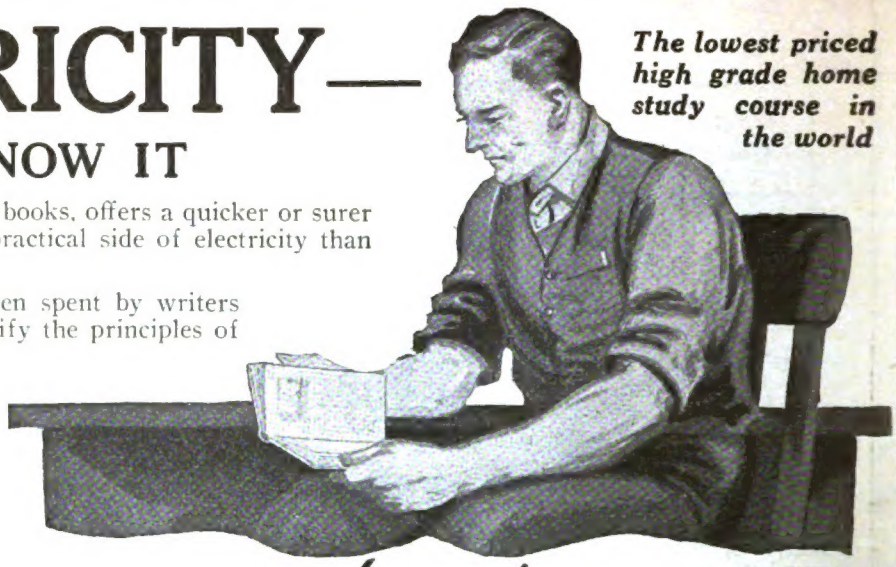
Digitized by Google

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ELECTRICITY—

AS EXPERTS KNOW IT

The lowest priced high grade home study course in the world



NO course, no book, no set of books, offers a quicker or surer method of mastering the practical side of electricity than the Croft Library.

A quarter of a century has been spent by writers and teachers in an effort to simplify the principles of electrical practice.

The pinnacle in self-help educational literature has been reached in the Croft Library.

It is different from any other literature of the kind in existence. It is founded purely on work as it is done. It is built by a practical man. It is practice itself. It will actually save any man about 90% of the usual apprenticeship period.

Even the beginner can understand it. And it is the daily guide of thousands of highly paid electrical workers and engineers.

Whether you are experienced or not, you can entrust your entire electrical education to the Croft Library.

"Know electricity as experts know it."

Don't be content with $38 to $50 per week

Don't be content with just a fair knowledge of electricity. Don't be satisfied with the average electrical worker's salary of $38 to $50 per week. Know electricity as experts know it. Terrell Croft will tell you how.

Learn while you earn

NOT ONE CENT IN ADVANCE

Merely fill out the coupon below and return to us for ten days' absolutely free examination of the CROFT LIBRARY OF PRACTICAL ELECTRICITY. Use the books in connection with your work for ten full days. See how the hundreds of problems in electrical practise are cleared up in simple language and illustration. If thoroughly convinced that the books will enable you to know electricity as experts know it, send us the small monthly payments mentioned in the coupon below. Return the books at our expense if not entirely pleased.

8 Volumes
Flexibly bound
Pocket Size
3000 pages
2100 illustrations
Everything you must know about electricity at the finger's end

A letter that means something to YOU—

McGraw-Hill Book Co., Inc.,
370 7th Ave., New York, N. Y.

Gentlemen:—In an attempt to express myself about CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY, I have never seen, and do not believe there was ever printed in the English language, a more comprehensive set of books. It is a library that is just as valuable to the novice as to the expert, because it is all practice. Respectfully,

GUY H. PEIFER,
Chief, Doplan Silk Corporation,
Hazleton, Pa.

McGRAW-HILL BOOK CO., Inc.
370 7th Ave., New York

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc.,
370 7th Ave., New York.

Gentlemen:—Please send me the Library of Practical Electricity (shipping charges prepaid), for ten days' free examination. If satisfactory I will send $3 in ten days and $3 per month until $27.50 has been paid. If not wanted, will write you for return shipping instructions.

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation ..... S & I-4-21

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Volume VIII.
Whole No. 96

Science and Invention

H. GERNSBACK,- EDITOR
H. WINFIELD SECOR,- ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D.,- ASSOCIATE EDITOR

APRIL
1921
No. 12

200-Mile-Per-Hour Air-Propelled Railway

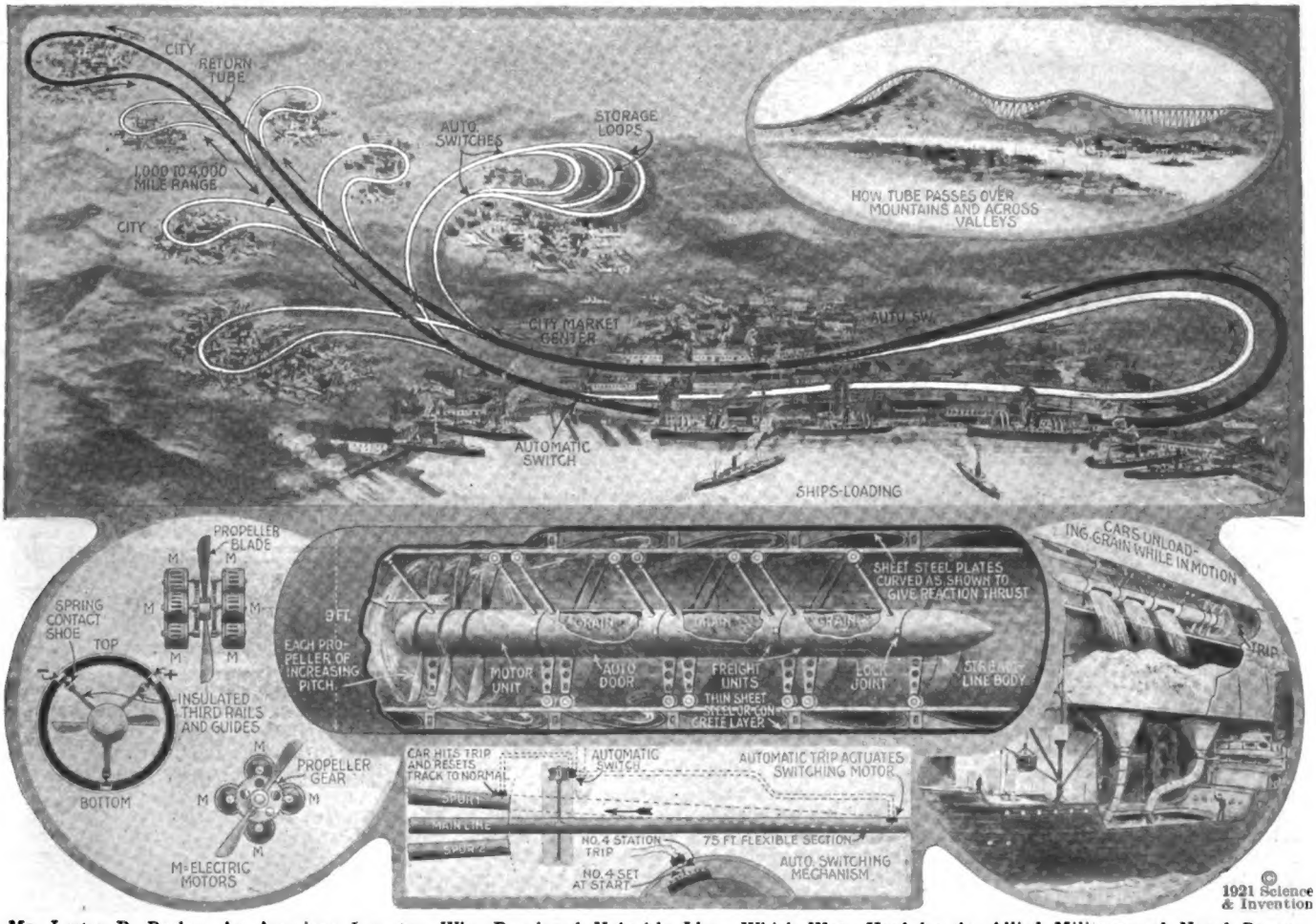
SEVERAL years ago, a Russian engineer and genius who was visiting the United States, proposed a remarkable scheme for carrying passengers as well as freight, mail and other matter thru a tubular railway system at velocities of 200 miles an hour and more, but the principal disadvantage of his system was that it was supposed to operate by a vacuum, i.e., the tubes were to be exhausted of air. Such a system as this would seem to our practical minded engineers, as being really too elaborate both from the operating as well as the constructional cost point of view.

An American inventor, Lester P. Barlow, who devised many ingenious devices successfully applied in the World War, and which helped the Allies to conquer the power of the Teutonic forces, has come forward with what appears to be a very clever invention for carrying mail and other material between different sections of the largest cities as well as between such cities as New York, Chicago, New Orleans, St. Louis, Philadelphia, etc.

In a few words, what Mr. Barlow intends to do, is to provide a steel tube, which need not be air-tight, and thru which a series of carriers or cars will shoot along at a speed of 200 miles or more per hour, being forced thru the tube at this high velocity by means of an aerial propeller or a series of three such propellers, mounted a short distance apart on the forward end of the engine unit of the train as shown.

These propellers are driven by electric motors, the motors receiving their electrical energy thru two insulated power rails as shown in the diagram in the accompanying illustration. The bottom rail is the main carrier member and takes the

(*Continued on page* 1340)



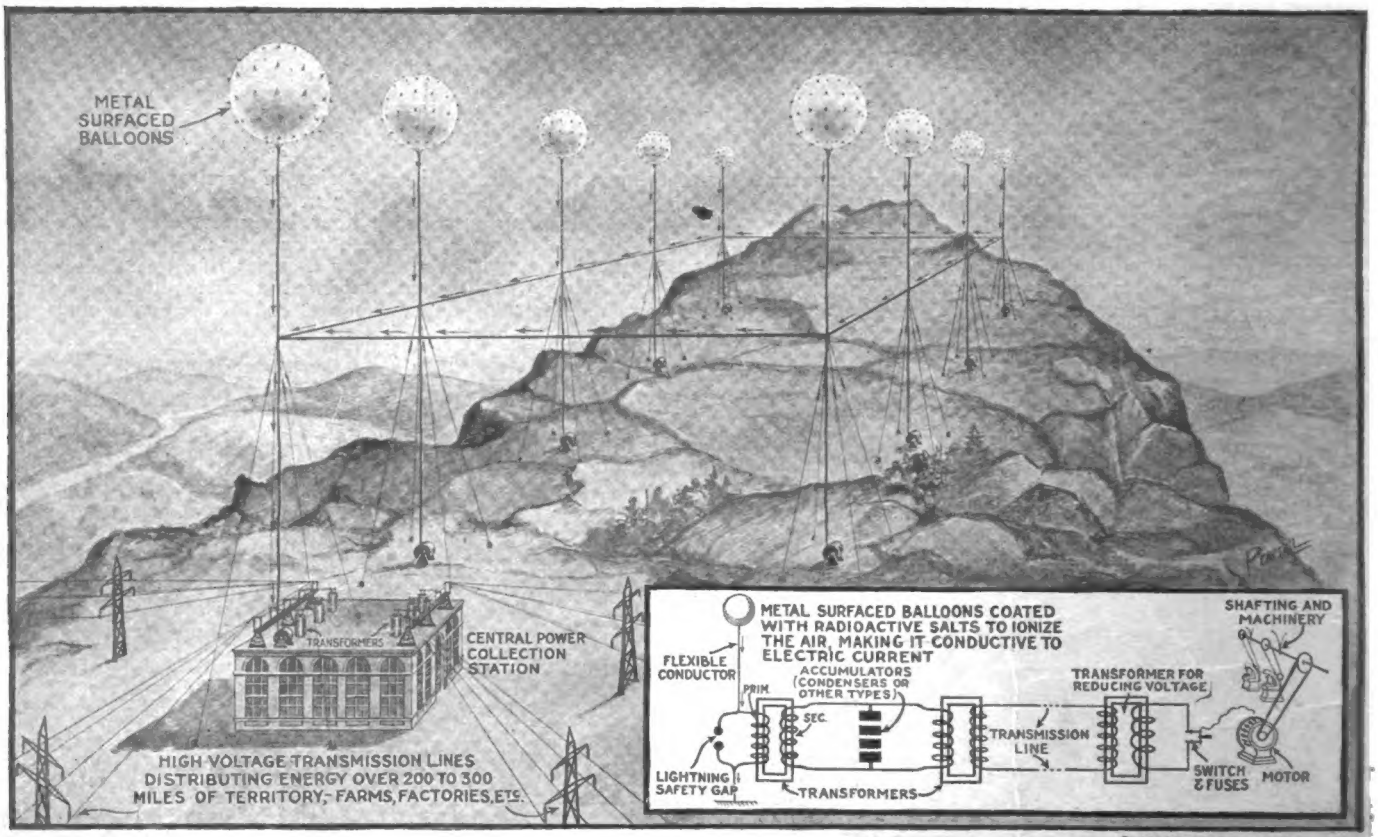
Mr. Lester P. Barlow An American Inventor, Who Developed Valuable Ideas Which Were Used by the Allied Military and Naval Powers During the World War, Has Turned His Talents Towards Peace-Time Uses, and Here Suggests a Remarkable Air-Propelled Railway, the Cars of Which Are to Be Propelled by Air Screws Similar to Those of Airplanes, At a Speed of 200 Miles An Hour or Greater. The View At the Top of the Illustration Shows How the Light Steel Tube Might, for Example, Connect the Principal Cities Along the Mississippi Valley From Chicago to New Orleans, Enabling Grain and Other Commodities to Be Automatically Transported Between Cities or Between the Great Lake Ports At the North and the Famous Gulf Port At the South With a Maximum of Speed and a Minimum of Labor. As the Detailed Drawings Show, the Cars Are Much Smaller Than the Tube So As to Provide Space for the Air Currents. The Cars Are Propelled by Electric Motors, the Current Being Fed to These Motors by Two Insulated Rails and Suitable Contact Shoes. Mr. Barlow Has Worked Out Details Whereby the Cars or Carriers Can Discharge Their Cargoes, While They Are Still in Motion, As Shown At the Left.

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ıectric Power From the Air

THE utilization of free electrical energy in the atmosphere surrounding our earth, has proven the magic goal towards which inventors have striven for several generations; but until recently there has been practically no headway made toward reaching the desired result—the obtaining of power from the air for economic uses.


METAL SURFACED BALLOONS
TRANSFORMERS
CENTRAL POWER COLLECTION STATION
HIGH VOLTAGE TRANSMISSION LINES DISTRIBUTING ENERGY OVER 200 TO 300 MILES OF TERRITORY,- FARMS, FACTORIES, ETC.
METAL SURFACED BALLOONS COATED WITH RADIOACTIVE SALTS TO IONIZE THE AIR, MAKING IT CONDUCTIVE TO ELECTRIC CURRENT
FLEXIBLE CONDUCTOR
ACCUMULATORS (CONDENSERS OR OTHER TYPES)
PRIM.
SEC.
TRANSFORMER FOR REDUCING VOLTAGE
SHAFTING AND MACHINERY
TRANSMISSION LINE
LIGHTNING SAFETY GAP
TRANSFORMERS
SWITCH & FUSES
MOTOR

© 1921 by Science & Invention

Free Electrical Energy From the Atmosphere Has Long Been the Dream of Electricians and Scientists the World Over, But Little Has Been Done Up Until the Present Time in Trying to Adapt the Tremendous Quantities of Free Electrical Energy Existing in the Atmosphere to the Everyday Utilitarian Requirements of Mankind. The Present Article Deals With Some Recent Experiments Carried Out by Dr. Plauson, a German Engineer, Which Have Shown Some Very Interesting Results. It Is Said That This Scientist Has Successfully Demonstrated, That If We Send Up Metal-Surfaced Balloons and Tap the Electrical Energy From the Atmosphere At a Level of 1000 Feet or More, We Shall Be Able to Realize an Average of 200 H. P. Per Square Meter, an Area Equivalent to 10.8 Square Feet.

In the early days of electric lighting, that is, back in the 70's and 80's, there were a number of scientific experiments carried out which received a great deal of publicity at the time, and whose recitals described how in the immediate future we would undoubtedly obtain our electrical energy for lighting and power purposes, from the atmosphere. But, as aforementioned, there has been practically nothing done in this direction until the present time, and there is a very good reason why but little has been done by scientific investigators and electricians in endeavoring to harness the natural electrical forces of nature, as resident in the atmosphere, for the everyday utilitarian requirements of mankind. This reason lies in the fact that the electrical power of nature, particularly when so-called thunder or electric storms hover above us, are not to be trifled with.

Recently there have appeared in a German publication, some notes on the new discoveries and experiments of a German scientist residing at Hamburg,—one named Plauson. Plauson has studied the subject of atmospheric electricity and its utilization for many years, and he has recently come forward with a clever scheme for putting to work this free energy of the atmosphere. It is said that he has successfully demonstrated that if we send up metal-surfaced balloons or other surfaces and tap the atmospheric electrical energy, at elevations in excess of 1,000 feet, we shall be able to realize an average of 200 horse-power per square meter, which area is equivalent to 10.8 square feet. It is even claimed that in his latest experiments, as great a quantity of electrical energy as 400 to 500 horse-power has been realized per square meter.

The atmosphere or air above the earth's surface, in normal weather, is charged with electricity, thus constituting an electrostatic field which is almost uniform and in which the surfaces of equal potential are parallel to the earth, or in which the lines of force are vertical. In the event of violent atmospheric disturbances such as before or after, and of course, during the course of electric storms, the atmospheric potential fluctuates and changes in polarity very markedly, as careful scientific investigation and measurements carried out in various parts of the world, have demonstrated.

Under normal weather and atmospheric conditions, the potential gradient, as it is called, of the atmosphere increases with comparative regularity as we rise above the surface of the ground. The atmospheric potential per foot or meter of altitude varies also, as may be well imagined, with the season of the year, and this potential or voltage has been found to average 100 volts per meter (3.28 feet) in the summer months, while during the cold winter weather, the potential gradient often rises to as high as 300 volts per meter. This may seem somewhat hazy and in fact almost impossible of belief to the average person, and there are two reasons why we do not notice this startling difference of potential for every meter increase as we are elevated. One of these is that the electrical energy is mostly in the form of high voltage static electricity, but of small quantity, similar to that given off from large static machines. If you have ever stood under the discharge terminal of one of these machines and felt the *electric breeze* which sometimes causes the hair to stand vertically from the head owing to the very high voltage (but relatively small amperage or current present), the emf., of which may easily have been several hundred thousand volts, you were given a practical demonstration of how the atmosphere may be highly charged electrically and yet be unnoticed by the usual organs of sense.

Another reason why we know nothing of this increase in potential with elevation is that the experimenters usually do not have the proper instruments with which to measure the atmospheric potential, and therefore often lose sight of the fact that in the winter, for example, we may have present an emf. of 100 volts per foot. These high potentials, owing to their static nature, are measured by a very delicate electro-static voltmeter. Those interested in this phase of atmospheric electricity will find descriptions of the apparatus used, as well as results and meas-

(*Continued on page* 1343)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Lifting Stunts for Your Parlor

Some Interesting Paradoxes in Everyday Physics Including the "Johnny Coulon Lift" and Why Miss Annie Abbott, the "Georgia Magnet," Cannot be Lifted

FOR several months a young American athlete and pugilist, one Johnny Coulon, has been interesting the French public with his remarkable demonstrations of a seemingly mysterious magnetic or other power, which, call it whatever you like, has effectually prevented the strongest men in Europe from lifting his 110-pound body from the floor.

There are a number of interesting and striking preliminary experiments in physics, which, if you have not already tried them out, will provide suitable entertainment for your friends. With the aid of the accompanying illustration, we will attempt to elucidate some interesting preliminary "stunts," before taking up the methods whereby Miss Annie Abbott, the "Georgia Magnet," Johnny Coulon, and others have defied a single man or a group of them, to lift the performer from the ground.

Fig. 1 in the illustration herewith, shows a simple experiment which will prove quite surprising even when performed with a child. It is usually more effective when performed with the aid of a young woman; the lady placing either one or both of her hands firmly on top of her head as shown. You will find that it is practically impossible in most cases to lift a single hand from the head, or if both hands are claspt together with the fingers closely locked and held firmly down on the head, the entire body can be lifted by pushing upward under the arms at the wrists, but rarely is it possible to push the hands upward from the head.

The second experiment is illustrated at Fig. 2. A woman is best selected as the subject, and it doesn't matter whether she is particularly athletic and strong or not. The results will usually prove sufficiently surprising, regardless of this factor. If the subject places her hands firmly against her chest with the finger tips just touching, it will require a strong man to pull the hands apart; if the lady's wrists are grasped firmly an attempt to pull the hands apart is futile. One attempting to separate the lady's hands must not stand sidewise or attempt to jerk the hands, but he must exert a steady pull, at arm's length or with the arms bent so as to improve the leverage, which will give a greater resultant pull.

A simple little experiment to demonstrate the great power of the female of the species over the male, and one which will nonplus any athlete is illustrated at Fig. 3. If the man (it doesn't matter how big or muscular he may be) doubles up his fists and places one over the other, you will be surprised to find that even a young boy or girl can, by simply snapping one finger of either hand against each of the two fists, separate them every time. And more paradoxical still, the harder the "strong man" attempts to hold his fists together, the more easily are they separated.

LIFTING THE HUMAN BODY WITH FIVE FINGERS.

What is known as the *five finger lift* is illustrated at Fig. 4, and this provides considerable fun and scientific entertainment for parlor and club gatherings. If it is desired to put the experiment on with sure-fire success, the manager of this little act should take precautions to have his committee of four men lift the subject, picking out preferably a lady weighing about 130 to 140 pounds. If good muscular men are selected for the committee, which can usually be arranged, a woman weighing 150 to 200 pounds can be lifted with ease. The editors have tried this experiment successfully many times and with four men of the average muscular development, succeeded in thus lifting easily a 140-pound woman.

(*Continued on page* 1352)

— Try these "Physical Stunts" in your parlor —
ALL BASED ON PARADOXES IN APPLIED PHYSICS.
1 WITH HAND ON TOP OF HEAD IT IS USUALLY IMPOSSIBLE TO LIFT THE HAND FROM THE HEAD
2 MAN CANNOT PULL HANDS APART, EVEN THOSE OF YOUNG GIRL OR BOY.
FINGERS TIP TO TIP
3 2 FINGERS FOOL THE STRONGEST MAN
FINGER UNDER CHIN
THIS MAN HOLDS ONE FINGER UNDER EACH ARM
4 EASILY LIFTING A WOMAN WITH FIVE FINGERS
5 THE SECRET OF LIFTING ANY PERSON BY THE ARMS.
NOTE MEN CAN STAND ERECT WHILE LIFTING
6
7 THE "JOHNNY COULON LIFT.
1. THE LIFT IS ALLOWED
2. WITH THE SUBJECTS FINGERS PLACED AS SHOWN THE LIFT CANNOT USUALLY BE MADE.
8 AS MANY AS 25 TO 30 MEN HAVE APPEARED IN THIS EXPERIMENT. THE RESISTING POWER OF THE WOMAN SUBJECT IS ASTOUNDING.

A Number of Scientific Parlor Stunts Are Illustrated Above. First We Have a Few Simple Hand and Finger Tricks, Winding Up With the "Georgia Magnet" and "Johnny Coulon" Lifting Stunts, Which Will Surprise You, Once You Have Tried Them.

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Typewriting and Stenographic Machines for the Blind

Translated from the French by Prof. T. O'Conor Sloane, Ph. D., LL. D.

WE are indebted for this article to M. Jacques Boyer, already well known to our readers as one of the leading scientific writers of France, and to whom we have already been indebted for interesting material for our columns. The recent introduction of several stenographic writing machines for the blind, notably those by Prof. Villey and Lieut. Muller, was the origin of this article, these machines enabling the blind to produce in relief-characters at stenographic speed, the reports of a lecture or of dictation as quickly as the regular stenographer, but it is quite interesting before going into the description of these machines, to trace the origin of what are called dactylographs for the blind. This is the technical name for a typewriting machine.

Going back to the 16th century, in Spain and in Italy the idea was formed of engraving letters in intaglio on wooden surfaces, to be used in printing for the blind. In 1640 a writing teacher of Paris, Pierre Moreau, made metallic types for the same purpose, but he obtained no success in his enterprise. So it is fair to say that the production of books with characters in relief goes back to the days of Valentin Haüy, a famous French inventor and student. The famous English blind mathematician, Nicholas Sannderson (1682-1739) invented an apparatus which permitted him to do mathematical operations of very complicated order, by the sense of touch. He used a tablet pierced with holes, receiving pegs of various sizes, whose value was determined by the place they occupied on the tablet, so that he was able to do the most varied kinds of calculations.

Shortly after his day, Mlle. Salignac and du Puiseaux, the latter a blind man, used relief characters for reading. Then the German, Weissenbourg, stricken with blindness at the age of seven years, produced relief maps for the blind. This goes back to the days of the celebrated Valentin Haüy. He retained the ordinary letters, putting them in relief, to be read by touch. He taught a special writing to his pupils, and had a special type cast for his books.

The effect of all this is well exprest in the words of Prof. Villey: "They spoke to the fingers, with the language of the eye." This is claimed to mark a psychological error and this error seems to be eradicated, if for the lines composing ordinary letters definite arrangements of points are substituted.

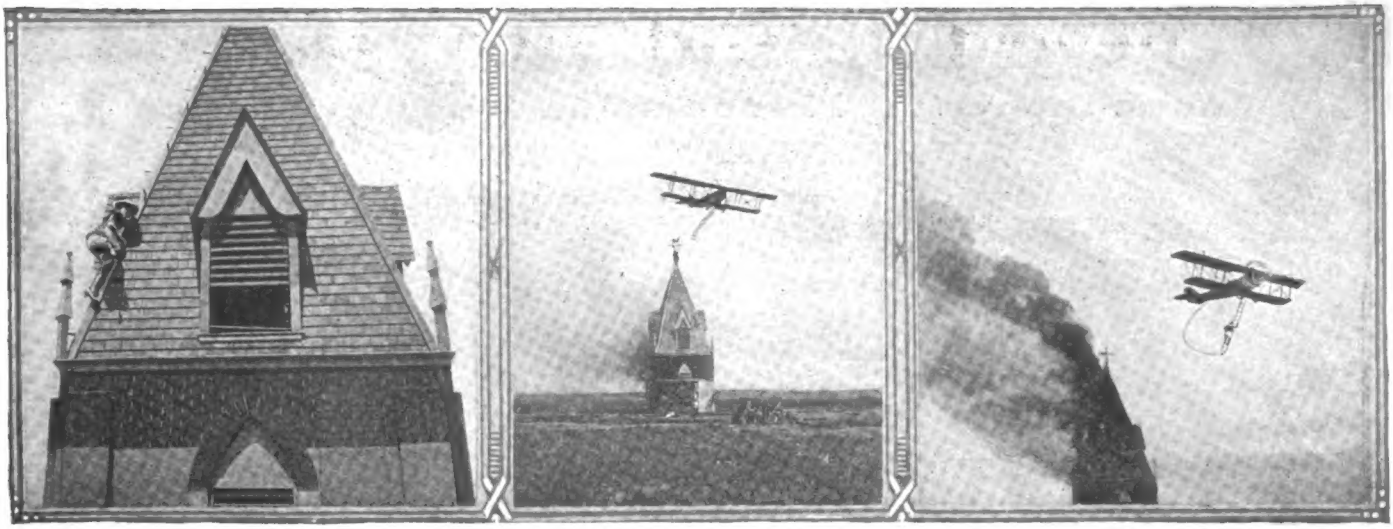
It is possible to keep the number of points used for each letter, quite restricted, and the origin of this system goes back to Charles Barbier, in 1821, but later Louis Braille, born in Lagny in 1809, blind himself, developed his famous alphabet, sometimes called "anaglyphic"; for a letter he used a maximum of six points, three high and two wide, and out of these he obtained 63 combinations. The Braille system is now universally adopted. The beauty of this system is, that it not only enables quick reading to be done, but by the use of a writing tablet, the blind can write it with a stylus, as easily as the more fortunate seeing people can write with a pen or pencil.

Braille's next effort was to produce a point writing which could be read by eye as well as by touch, putting the blind in direct communication with those who see, and while this was a slower writing, it gave the inspiration to the work of the celebrated blind investigator, Foucaux. He was blind from the age of six years and he invented the machine termed the *raphigraph*,—the first writing machine for the blind. This goes back nearly to 1843. In 1850 the same inventor developed another machine for printing which produces each character by a single blow. The apparatus was rather bulky, having 60 keys; only two such machines were ever constructed, altho the operator received a gold medal at the London World's Fair of 1851. In 1855, an Italian lawyer, Ravizza, produced a machine, which, operated from a keyboard, employed a set of type-arms arranged in a circle. This is suggestive of the early typewriters, and we find that in 1856, Mr. A. E. Beach, editor and one of the proprietors of the "Scientific American,"

(*Continued on page* 1338)

The Hall-Braille Machine Long in Use in the United States.
A Blind Operator Doing Stenographic Work On the Villey Machine.
Lieut. Muller (Blind) Operating His Stenographic Machine. Observe His Decorations for Bravery.
The Stainsby Machine in Extensive Use in England.
An Example of the Braille Embossments Now in Use.
Foucaux raphigraph, the First Typewriter for the Blind Invented in 1843.
The Constacon Machine of Switzerland,—a Typewriter for the Blind.
The Villey Stenographic Machine for Blind.
The Muller Stenoglyphe, Doing Shorthand for the Blind.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



Miss Jean Paige Climbing Church Steeple. The "Church" Ablaze—But an Airplane—Aha! Saves the Heroine With a Rope Ladder

Airplane Rescue in the "Movies"

NOT all moving pictures of thrilling scenes are "faked," as can readily be seen by the photographs showing in detail the aerial rescue here portrayed from a new Vitagraph serial, *Hidden Dangers*, in which Joe Ryan and Jean Paige co-star.

The action came very near terminating in a casualty. Jean Paige, a pretty little actress, was assisted to the top of a church steeple by means of pegs driven in the side, which were removed when she had climbed the spire. There, clinging to the cross, she awaited the onslaught of the flames which were by this time leaping upward toward her.

The church had just been set afire by some diabolical fiends who thought that the fire, added to her precarious position, would now make things "hot" for her, but her hero was on the job at a nearby flying station, tuning up his plane. When word was received at the air station of what was going on some few miles away, he started off post haste to the rescue.

Sighting the heroine and speeding up so that the flames would not set fire to any part of the wing structure or to his gasoline tank, he circled the church steeple while Jean Paige reached for the rope ladder hanging from the fuselage. She mist the bottom rung and was nearly thrown from her lofty perch, while the airplane circled again in another attempt to rescue her from the flaming steeple.

Things were now rather uncomfortable as the lower part of the steeple burst into a vivid roar of flame. The airplane ladder neared her again, and she took a chance. By sheer luck she held tightly to the ladder, and was whisked off at a 60-mile clip, which, is a very high speed to leap into from a stationary position.

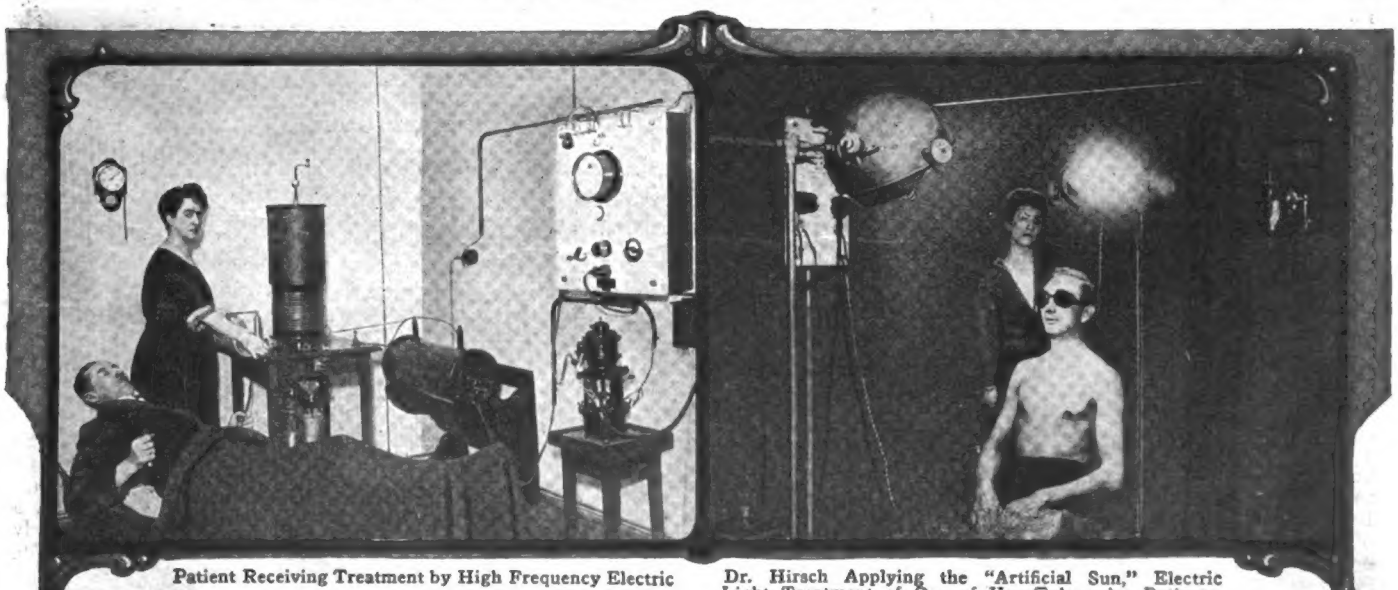
After the scene had been perfected, the aviator congratulated Miss Paige on her wonderful work, and we believe that she was well deserving of such praise. None of these scenes, however, were taken in the studio and the action portrayed is nothing short of miraculous.—*Photos Courtesy Vitagraph Films.*

Woman Doctor Cures by Electricity

THE accompanying photographs show two views of the latest electrical treatment sanatorium located in Berlin, which is presided over by Germany's foremost woman physician, Prof. R. Hirsch. This new electrical hospital has installed multiple sets of X-ray and high-frequency apparatus for the treatment of nervousness and the multifarious other ills which human flesh is heir to, and some idea of the size of this powerful equipment can be judged from the accompanying photographs.

Dr. Hirsch is a great believer in the treatment of diseases by electricity and massage instead of medicines, and in this part particularly, she is seconded by many eminent medical experts all over the world today. Prof. Hirsch has traveled in practically all of the countries of the world in search of the most powerful and the newest electric appliances with which to fit up her institution, which is said to be the finest of its kind to be found anywhere. One of the accompanying photographs shows Dr. Hirsch applying a high power apparatus to a patient suffering from rheumatism, while the second view shows the Doctor using the new high-powered electrically illuminated *artificial sun* in the treatment of a tubercular patient.

As will be noted, the patient wears dark, smoked glasses over the eyes to protect them from the intense brilliancy and heating effect of the rays produced by these lamps. The powerful light and heat rays are generated by mercury vapor lamps.



Patient Receiving Treatment by High Frequency Electric Currents in Berlin Sanatorium, Conducted by Germany's Eminent Physician, Prof. Dr. R. Hirsch.

Dr. Hirsch Applying the "Artificial Sun," Electric Light Treatment of One of Her Tubercular Patients. The Patient Wears Smoked Glasses to Protect His Eyes.

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Oddities of Physics

Some Interesting Phenomena in Everyday Physics

By H. WINFIELD SECOR

Associate Member, American Institute of Electrical Engneers

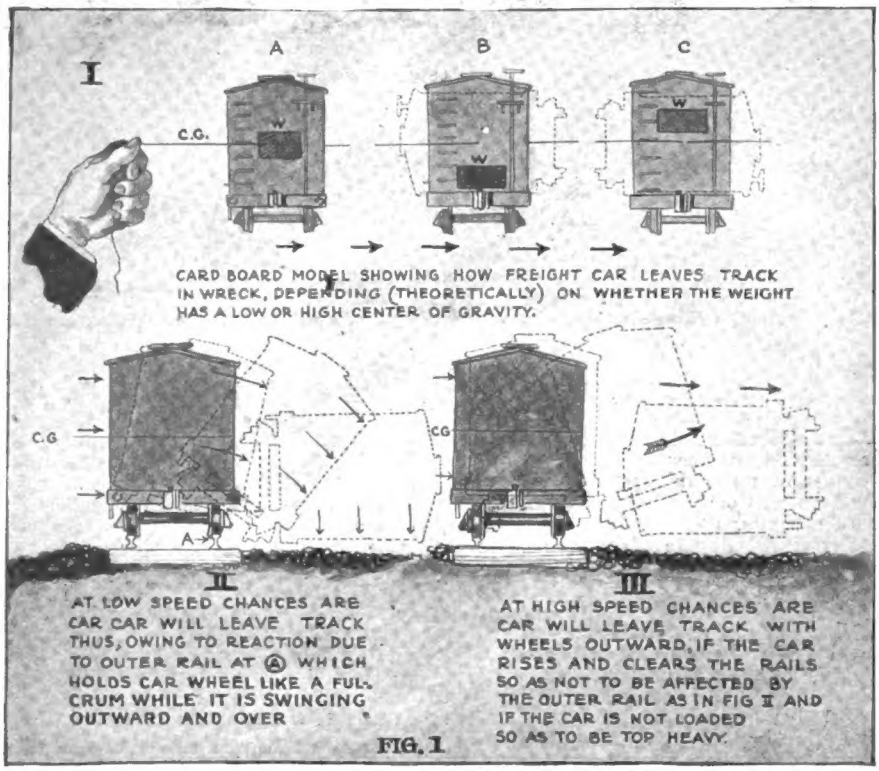

I
A
B
C
C.G.
W
CARD BOARD MODEL SHOWING HOW FREIGHT CAR LEAVES TRACK IN WRECK, DEPENDING (THEORETICALLY) ON WHETHER THE WEIGHT HAS A LOW OR HIGH CENTER OF GRAVITY.
C.G
CG
A
II
AT LOW SPEED CHANCES ARE CAR CAR WILL LEAVE TRACK THUS, OWING TO REACTION DUE TO OUTER RAIL AT Ⓐ WHICH HOLDS CAR WHEEL LIKE A FULCRUM WHILE IT IS SWINGING OUTWARD AND OVER
III
AT HIGH SPEED CHANCES ARE CAR WILL LEAVE TRACK WITH WHEELS OUTWARD, IF THE CAR RISES AND CLEARS THE RAILS SO AS NOT TO BE AFFECTED BY THE OUTER RAIL AS IN FIG II AND IF THE CAR IS NOT LOADED SO AS TO BE TOP HEAVY.
FIG. 1

Fig. 1. Which Way do Railroad Cars Fall in a Wreck,—with the Wheels Toward or Away from the Rails? The Three Principal Ways in Which Cars Will Fall When Rounding a Curve at High Speed Are Shown Above.

DO RAILROAD CARS FALL WITH THE WHEELS TOWARD OR AWAY FROM THE TRACKS IN A WRECK?

FREQUENTLY we hear the subject discust, and the question asked as to which way railroad cars, particularly freight cars, fall in a wreck, and the accompanying illustration shows some of the theoretical considerations which apply to this every-day phase of physics. The usual answer by railroad men is that the cars fall with the wheels to the rail and while this figures out theoretically for possibly the majority of cases, there have been cases where the cars fell with the wheels away from the track, and with the top of the car lying next to the rail. The present discussion applies, of course, to a string of cars traveling around a curve.

To convince oneself as to which way a railroad car, under these conditions, would tend to fall when thrown outward from the curved rails if traveling at too high a speed, let us have recourse to the simple cardboard model shown in the figure. This model can be made about 3" x 5" and cut to the shape of a freight car. A button or small piece of lead, etc., corresponding to a movable weight "w," and which can be secured in different positions by means of a pin or otherwise, permits us to change the center of gravity so as to give a low or high center of gravity. In the actual freight car the position of the center of gravity depends upon how it is loaded, with the predominating weight toward the bottom of the car and trucks or toward the top. A string is attached to the center of the cardboard car model and when the model is spun around in a circle horizontally, holding the string between the index finger and thumb, the effect will be clearly demonstrated and proves that the car will fall in one of *three* ways, to wit:

If the center of gravity or major part of the weight is low or toward the trucks, the car will fly off the rails with the wheels pointing away from them; if the weight of the car and its load is evenly distributed as by placing the dummy weight "w" at the exact center of the model, then the car will fly outward evenly, with regard to the top and bottom; and finally, if the center of gravity and the major portion of the weight is placed toward the top of the car, then the top will fly outward and the bottom inward, so that the car theoretically at least (and if no other force is present to alter this motion), will fall with the wheels toward the rail.

In actual wrecks, however, photographs frequently show a string of cars laying along side the rails with the wheels toward the rails, and it seems to be the usual result in an accident or wreck. Fig. II, of the accompanying diagram, shows clearly why this is so. Consider that the train is moving at an abnormally high speed around the curve so that the cars are subjected to great centrifugal force tending to throw them outward. If all the conditions are right, such as the center of gravity under the action of centrifugal force, the car will tend to turn outward and over, using the outer rail as a fulcrum—the cars will, in this case, invariably fall a few feet from the track with their wheels toward the rails.

A point often incorrectly entertained is that with cars going around a curve, at such a speed as to keep the wheels at one side only on the rail, the outer wheels would be the ones to lift off the rails and not the inner ones, but the reverse is true as Fig. II shows in demonstrating how freight cars usually fall.

Fig. III shows a case where the cars in a wreck due to rounding a curve at very high speed, can fall with the tops of the cars towards the rails. At abnormal speed which would result in the condition like that shown at Fig. III, and with the center of gravity or load or the major part of the weight placed low or toward the tracks, the car would fly outward by centrifugal force as shown by the dotted lines and the bottom of the car would turn out

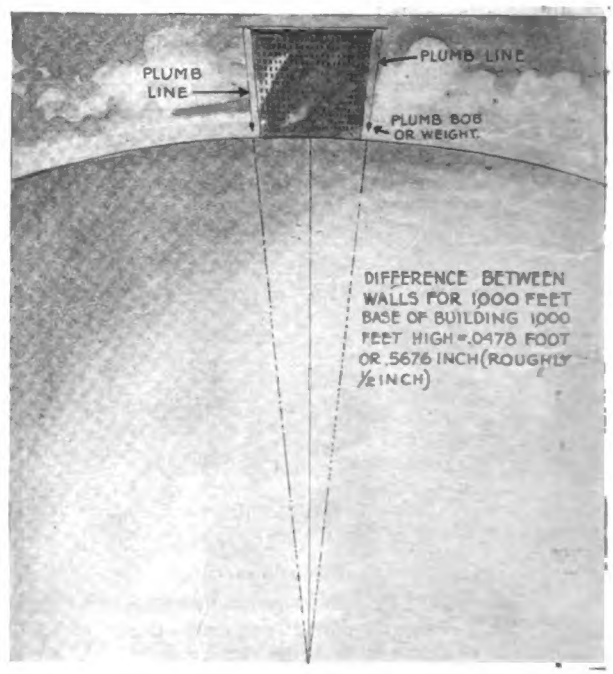

PLUMB LINE
PLUMB LINE
PLUMB BOB OR WEIGHT
DIFFERENCE BETWEEN WALLS FOR 1000 FEET BASE OF BUILDING 1000 FEET HIGH = .0478 FOOT OR .5676 INCH (ROUGHLY ½ INCH)

Fig. 2. When is a Plumb Line Not Plumb?—When It Lies on a Radial Line Passing Thru the Center of the Earth.—*Which is all the Time,* (Taking the Usually Accepted Meaning), and Thus if Two Sides of a Building are Erected to Correspond with Plumb Lines, They Will Not be Parallel, but Will be Found to be Farther Apart at the Roof Than at the Base of the Building. The Accompanying Illustration Shows the Difference in the Length of a Line Spread Between Two Walls of a Building at the Base, and Also at the Roof, the Structure Measuring 1,000 Feet Square and 1,000 Feet High; the Difference in This Case Would be a Trifle More Than ½ Inch.

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ward and up as shown by the arrow; the conditions for this result being that the car moves at a sufficiently high velocity to cause it to be virtually lifted from the rails, so that the wheel flanges clear them. Otherwise, the result is more likely to be that of case II, if the wheels do not clear the rails or if the rails do not spread, or otherwise fail so as to nullify or eliminate any reaction pressure on the outer rails.

ARE HOUSE WALLS PERFECTLY PARALLEL?

When we build a house or other building and providing the usual degree of mechanical craftsmanship is applied in its construction, we might expect to find upon accurate measurement, that the four walls measure exactly the same distance apart at the base of the building as at the top. But such is not the case, however, as physics proves to us, for upon a little reflection it is evident to anyone that this is impossible, especially when Fig. II is examined. Where only the usual methods of construction are applied, i. e., plumbing

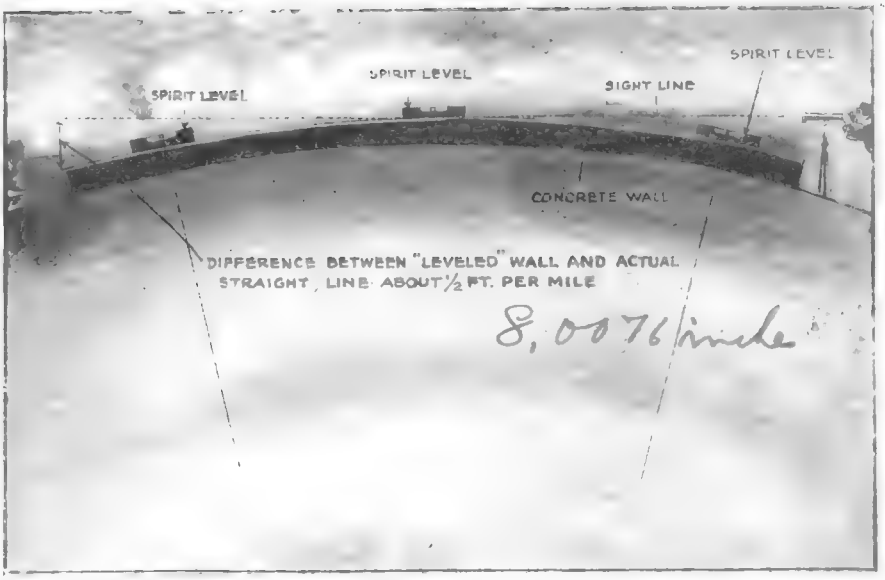


Fig. 3. The Diagram Above Shows that a Wall Constructed with Spirit Levels is not Perfectly Straight, but Curves in Accordance with the Curvature of the Earth. The Only Way to Erect a Perfectly Straight Wall Would be by Means of a Perfectly Taut Wire, or Else by Sighting Thru a Leveling Telescope as Shown in the Picture Herewith.

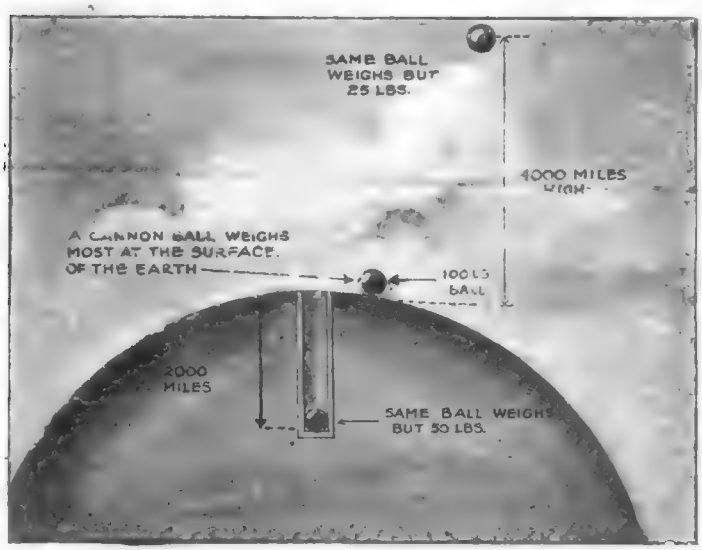

SAME BALL WEIGHS BUT 25 LBS.
4000 MILES HIGH
A CANNON BALL WEIGHS MOST AT THE SURFACE OF THE EARTH
100 LB BALL
2000 MILES
SAME BALL WEIGHS BUT 50 LBS.

Fig. 5. Where Does a Cannon Ball Weigh the Most? You Might Not Think it, but it is a Fact a 100 Pound Ball (or any Other Body), for Example, Will Weigh the Most at the Surface of the Earth—and Less Than That Amount When Raised Above or Lowered Below the Earth's Surface.

means! The truth of the matter is that such a wall is curved and actually follows the curvature of the earth. The writer remembers hearing this point argued many times, and it makes an interesting point for debate, you can well believe.

Illustration 3 demonstrates that a straight wall cannot be constructed by leveling, that is by leveling in the ordinary manner, for the reason that the level will act the same as the plumb bob, and it simply indicates that the bottom of the level is at right angle to a radial line pointing to the center of the earth, *and at that particular point only*. As soon as you move the level to a new point, even if only a few feet away, and providing you had instruments sufficiently accurate to measure the difference, you would find that the level has indicated a tangential point on the earth's surface for that particular radial line only.

It has been computed that when

(*Continued on page* 1330)

the walls with the usual plumb line and weight or bob, it is not possible for either the side walls, or the front and rear walls to be parallel to each other or the same distance apart at the top and bottom except from inaccuracy of construction.

They must be farther apart at the top than at the bottom, as each individual wall will, if lined up with a plumb bob, be on a different radial line from the center of the earth; and the chord of the angle subtended between two radial lines as shown in the drawing, will increase progressively as we move outward from the center of the earth. Building constructors, architects and engineers are familiar with this fact and in large buildings or other constructional operations, this fact is taken into consideration. It has been computed that for a building 1,000 feet long and 1,000 feet high, the walls, if simply plumbed with a plumb and bob, would be one-half inch farther apart at the top than at the base. As the height increases, so does the difference in the chords or distance between top and bottom walls; further, as the distance between the two walls increases, the difference of chords at top and bottom of the walls will likewise be augmented.

IS A LEVEL WALL STRAIGHT?

When it comes to building long concrete walls, dams and other constructional projects a mile or more in extent, we once again bump unconsciously into the inexorable laws of Nature and for once in our lives find that a *level wall is not straight*, by any

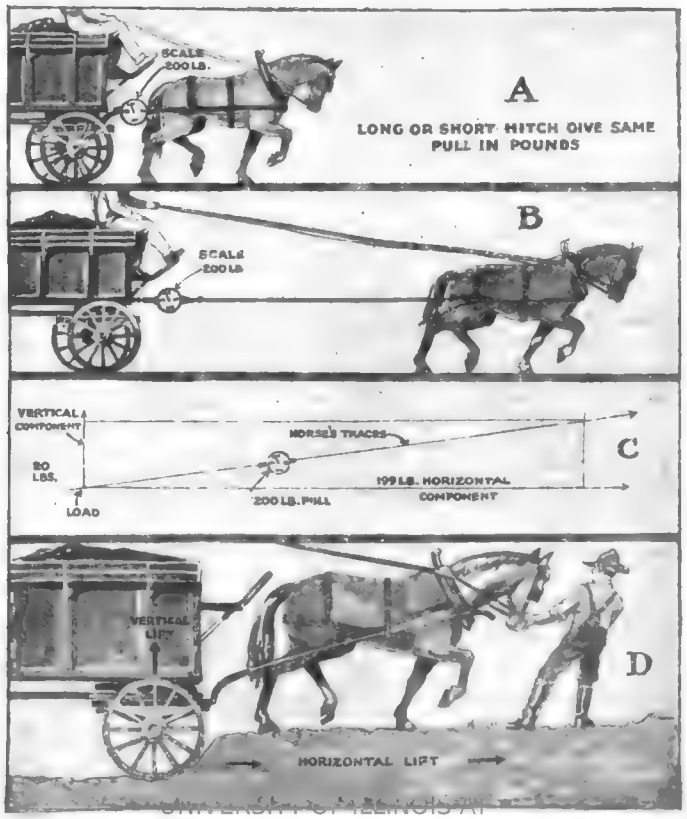


Fig. 7. Which is the Best,—a Long or Short Hitch in Pulling a Given Load? Figures "A" and "B" Show that When the Traces are Straight, this Actually Makes no Difference; But When the Traces are on a Slant or Angle, a Greater Pull Under Certain Conditions is Realized Owing to the Combination of Vertical and Horizontal Forces. In Figure "D," for Example, the Driver Stands a Better Chance of Hauling the Wagon Out of the Gulley with a Short, Angular Hitch Than with the Traces Horizontal, Owing to the Upward Force Brought into Play as the Resolution of Forces Diagrammed at Figure "C" Prove.

Digitized by Google
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

How Big Are Molecules?

By ROGERS D. RUSH, M. A.

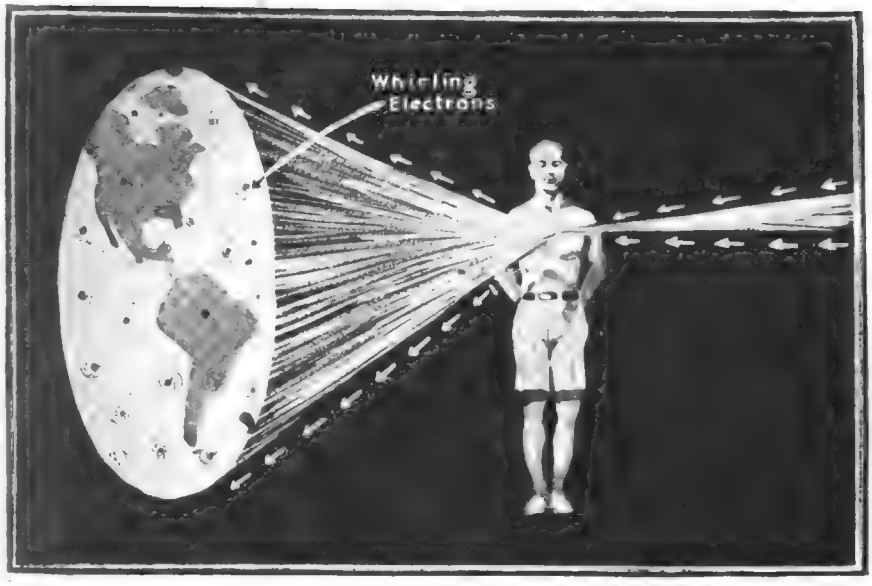


Fig. 5—To Gain Some Idea of the Extremely Minute Size of the Electron, of Which All Matter Is Now Supposed to Be Constructed, Imagine a Powerful Beam of Light Focust on to a Spot on the Human Body as Big as a Pin-Head, and the Reflected Ray Then Magnified to the Size of the Earth, or 8,000 Miles in Diameter. The Whirling Electrons Would Then Appear Visible to the Human Eye in the Manner Shown at the Left.

HOW big are molecules? Nobody has ever seen one and yet everybody talks about them. All matter is composed of them but molecules are in turn composed of atoms which must be smaller still. How big a molecule is depends on the atoms of which it is composed. Of these there are about ninety different kinds known to science that comprise the elements from which all other substances are built up.

Radium atoms are among the heaviest known and hydrogen atoms are the lightest. The former weighs two hundred and twenty-six times as much as the latter, while strange as it may seem, scientists believe radium atoms are but little over twice as large as those of hydrogen. Similarly, an atom of lead is eight times heavier than an atom of aluminum, altho it is but little larger in size, while an atom of tin is about midway between the two as shown in the first diagram.

Molecules, on the other hand, vary greatly in size because they are made up of different numbers and combinations of atoms. A water molecule contains two hydrogen atoms and one of oxygen as indicated by the familiar symbol H_2O, but it is little larger than a large atom. A single starch molecule, however, contains about twenty-five thousand atoms and is one of the largest molecules known (see Fig. 2).

Just what an atom or a molecule looks like no one knows and perhaps no one will ever know, for they are too small to be visible in any present day microscope. It is estimated that a thousand or perhaps a few hundred large molecules might make a visible speck in an ultra-microscope, but even then it would only appear as a point of light and no contour would be visible. However, if we do not know what molecules look like, we know they act just as if they are round balls, and when a liquid is boiled away or evaporates they fly off like miniature rifle balls, forming a vapor or steam.

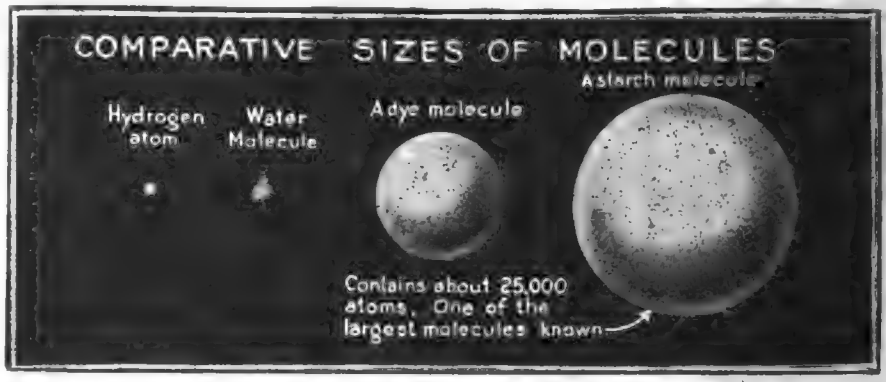

COMPARATIVE SIZES OF MOLECULES
A starch molecule
Hydrogen atom
Water Molecule
A dye molecule
Contains about 25,000 atoms. One of the largest molecules known

Fig. 2—This Diagram Shows in a Clear Manner the Relative Size, Magnified Thousands of Times, of Course, of the Hydrogen Atom, the Water Molecule, a Dye Molecule and a Starch Molecule—the Latter Containing About 25,000 Atoms, and Being One of the Largest Molecules Known to Science.

Steam is another familiar substance with which everybody is acquainted but which nobody has ever seen. Most people think they *see* steam when they look at the cloud issuing from the mouth of a teakettle or the exhaust of a locomotive, but they are mistaken. What they see is the vapor which has condensed in the form of a fog or a cloud of small water droplets, but steam itself is invisible because it is impossible to see the separate molecules and when the molecules join together they form minute drops of water, which are not steam. This may be easily proved by looking into a teakettle when the water is boiling. It is obviously full of steam, but there is nothing visible. If a baseball and a molecule of steam were magnified until the baseball was as large as the earth, then the molecule of steam would be about as large as the baseball was (see Fig. 4).

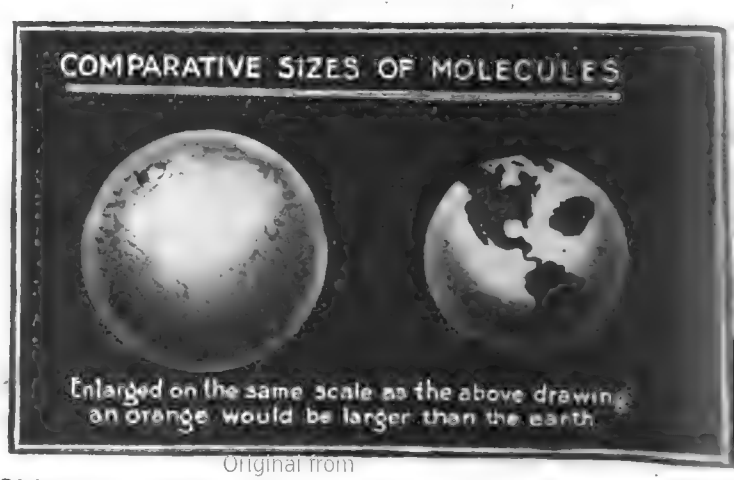
Fig. 3. Enlarged on the Same Scale as Fig. 2 Above, an Orange Would Appear Larger Than the Earth, as Shown by Our Artist in the Accompanying Illustration. This Also Emphasizes the Great Magnification of the Atoms and Molecules at Fig. 2.

Molecules are pretty small compared with baseballs, but when compared with electrons they are gigantic indeed. An electron is the smallest thing known and it has been proved that all atoms contain these minute electrical charges. The smallest atom known is as big as several million billion electrons, so after all, size is a relative matter and atoms are large or small depending on what we compare them with.

The human body is composed of numberless small cells (see Fig. 5) which we are accustomed to think of as being pretty small. They are easily visible in a microscope, however, and have been so studied for a long time. It is evident they are composed of thousands of molecules, which make the cell a complex organism capable of life and growth. Hence molecules tho small are not to be despised.

It is really never thought of, perhaps, by the average person, that his very body is composed of millions upon millions of tiny particles of live matter, which the scientist calls *electrons*. The electrons form atoms and the atoms in turn, molecules. Some idea of the extremely minute mass of the electron may be obtained from the fact that nobody has yet been able to see an electron thru the most powerful microscope, and probably never will. However, science has ascertained the exact size of the electron to a very high degree

(*Continued on page* 1324.)



Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

"Moviescope" Teaches Dancing

The boy in our illustration seems pleased with the idea of learning to dance by the aid of moving pictures. As he turns the crank and looks down into the machine, he sees an actual demonstration of the latest steps.

The idea was originated by Arthur Murray, a student at Georgia Tech. Some time ago, *Forbes Magazine* carried an article which stated that Arthur Murray has the largest dancing class in the world and earns $15,000 a year while going to college.

As the crank is turned, forty-two small leaves revolve around a barrel. By the rapid succession of falling leaves, the action of a dancing step is produced. The machine being operated by hand, the learner can turn as fast as he pleases and stop the movement at any time. By looking down into the machine for five minutes, the step is repeated more than one hundred times.

The process of making the finished picture requires some study as the little machine carries but 42 views and the action must be so timed and the step so arranged that the complete dancing step is photographed in exactly the same number of individual pictures. The 42 photographs then are enlarged on paper and are inked in by an artist who prepares them for the engraver, who in turn, makes line-cuts. The printer does the rest.

Dogs Carry Electric Lights

The Latest Thing in Hunting Novelties is an Electric Light Attached to a Collar, for Your Dog Which Becomes Extremely Valuable to His "Canine-Ship" When Trailing Game Into Dark Holes, Giving the Dog the Advantage of Preparing for His Defense and Attacking the Game Aggressively.

In all the European countries, particularly Portugal, hunting has been one of the most well famed sports.

However, it has heretofore been an extremely difficult and dangerous task for the hunting dog, following the scent of the fox or badger, to hunt the pursued game out of their burrows; this difficulty being due to the fact that the intense darkness encountered within the long, narrow burrows rendered the dog almost helpless.

But now, it has come to pass, that for the purpose of assisting the dog in his chase for the game, he is provided with a collar to which is attached an electric lamp. In a pocket of this collar there is placed a flashlight battery which supplies the necessary current for lighting the bulb.

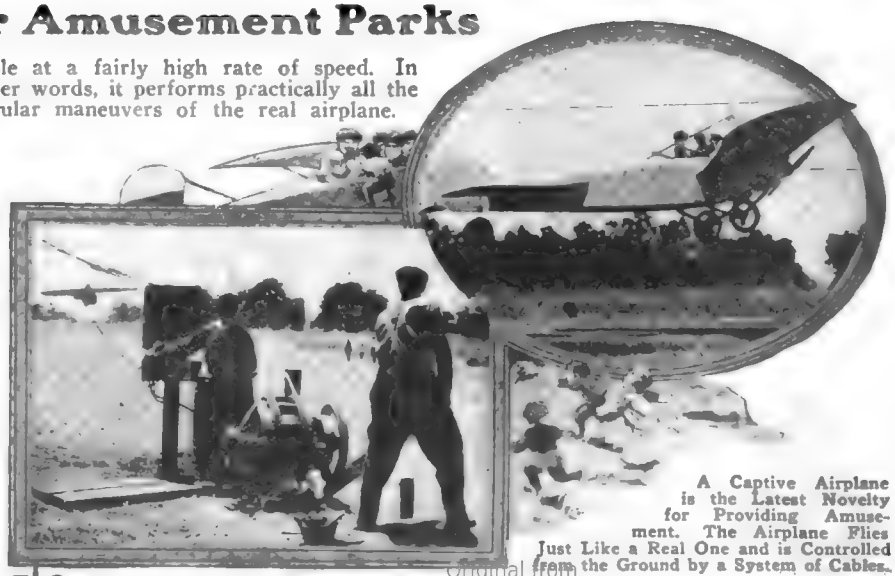
With this electric lamp which casts a beam of light a few feet ahead, it becomes an easy matter for the dog to work his way into the holes bored by the fox or badger.

Unique Thriller for Amusement Parks

One of the latest thrillers for places of amusement, is the new self-stabilizing "paraplane"—invented by R. R. Reed of Oakland, Cal. In the accompanying photograph is shown this new paraplane with its cockpit loaded with happy kiddies, flying without a pilot. It is controlled entirely from the ground, a man operating a switch arrangement for the propulsion of the plane carrying its precious load of children. A fifty horse-power electric motor furnishes the necessary power which is transmitted thru a system of cables.

This new amusement feature provides for the public, a real flight in the air in a real airplane, at a price which all can afford to pay.

What other amusement except a ride in the paraplane, could offer so much pleasure and thrill to the kiddies? It affords a delightful little trip, and is sure to please all after but one ride. The plane guided by cables, rises gradually to a predetermined height, and thence proceeds along a taut cable at a fairly high rate of speed. In other words, it performs practically all the regular maneuvers of the real airplane.



A Captive Airplane is the Latest Novelty for Providing Amusement. The Airplane Flies Just Like a Real One and is Controlled from the Ground by a System of Cables.

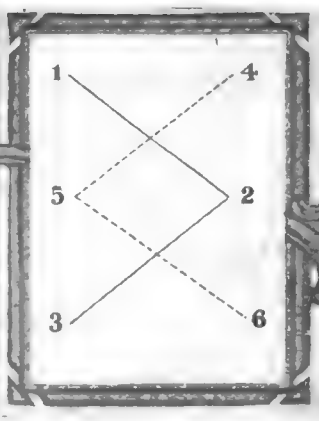
Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Peculiar Beetle Locomotion

Photo Showing Beetle in Flight With Legs Depending and Wings Extended from Their Coverings.

This Photo Shows a Ground Beetle in the Act of Walking.



How a Beetle Walks: Legs 1, 2 and 3 Move Forward, Then Legs 4, 5 and 6.

Surface Swimming Beetle Enlarged 4 Times. The Double-Eye Permits of Vision Above and Below.

IT is common knowledge that the things seen every day are not observed. One of the most common things in nature is the insect. Beetles are found everywhere. They are seen flying or else one can find them sitting on one and the same particular spot without motion, apparently lifeless. But if slightly disturbed the antennae will be seen to twitch and vibrate and if now closely observed one can see some insects inflate their body with air, spread their wing covers, and lift their membranous wings. All this goes on slowly, deliberately, but suddenly, with a whir, the insect is off on its flight. The peculiar thing about the flight of some beetles is, that the hard chitinous wing covers which are a protection to the delicate folded wings, are not used for propulsion in their flight. In some they are replaced on the back while flying, while in others they remain extended and act as gliders. Here the hind wings are used for flight and describe a figure eight while in motion. Under these circumstances the legs of the insect hang loosely downward.

Other beetles, the diving beetles, have the power of flight and also the power of diving under the water. When diving, these beetles collect a bubble of air on the under side of their abdomen and, with a swimming motion of their hind legs, and a pulling motion of their front legs, they glide under the surface of the water. Their hind legs are especially adapted for this purpose and are enlarged by the addition of hairs which give them a larger thrusting power under water. They use the bubble of air attacht to their abdomen for breathing and when they have exhausted it, they come to the top for a second and dive down again.

The common whirligig is another aquatic beetle. It is the ship of the ponds, a mighty racer, darting hither and thither upon the surface so quickly that the eye can hardly follow the individual. One would almost believe that their motion was more of a gliding on a polisht mirror than a swimming. The eyes of these beetles are peculiar, each being divided in half so that they have *four* eyes. The lower half of each eye remains under the surface of the water as the beetle glides about on the surface, therefore it can see under water. The other half remains out of the water and with it it can see into the distance.

Still another beetle is the ground beetle. These walk on the ground, and, in some species the wings are so rudimentary that they are never used for flight. Altho some of these insects are especially quick on their legs, their method of walking is peculiar. First they move their right leg forward, then their middle left leg, and finally their right hind leg. While their right hind leg is moving forward their left front leg also begins to move forward followed by their right middle leg and their left hind leg. When walking or running their motion is not jerky, but smooth and continuous.—Dr. E. Bade.

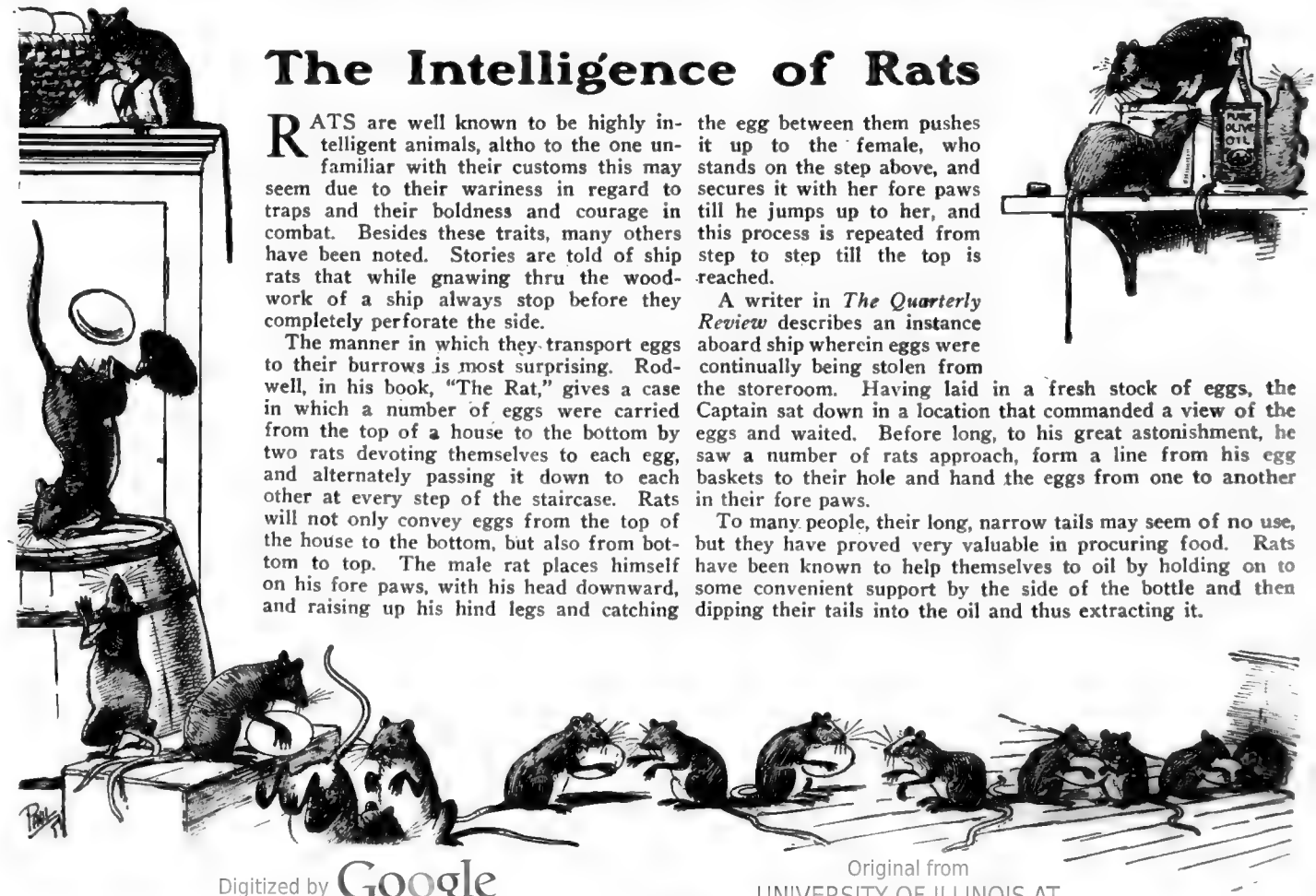
The Intelligence of Rats

RATS are well known to be highly intelligent animals, altho to the one unfamiliar with their customs this may seem due to their wariness in regard to traps and their boldness and courage in combat. Besides these traits, many others have been noted. Stories are told of ship rats that while gnawing thru the woodwork of a ship always stop before they completely perforate the side.

The manner in which they transport eggs to their burrows is most surprising. Rodwell, in his book, "The Rat," gives a case in which a number of eggs were carried from the top of a house to the bottom by two rats devoting themselves to each egg, and alternately passing it down to each other at every step of the staircase. Rats will not only convey eggs from the top of the house to the bottom, but also from bottom to top. The male rat places himself on his fore paws, with his head downward, and raising up his hind legs and catching the egg between them pushes it up to the female, who stands on the step above, and secures it with her fore paws till he jumps up to her, and this process is repeated from step to step till the top is reached.

A writer in *The Quarterly Review* describes an instance aboard ship wherein eggs were continually being stolen from the storeroom. Having laid in a fresh stock of eggs, the Captain sat down in a location that commanded a view of the eggs and waited. Before long, to his great astonishment, he saw a number of rats approach, form a line from his egg baskets to their hole and hand the eggs from one to another in their fore paws.

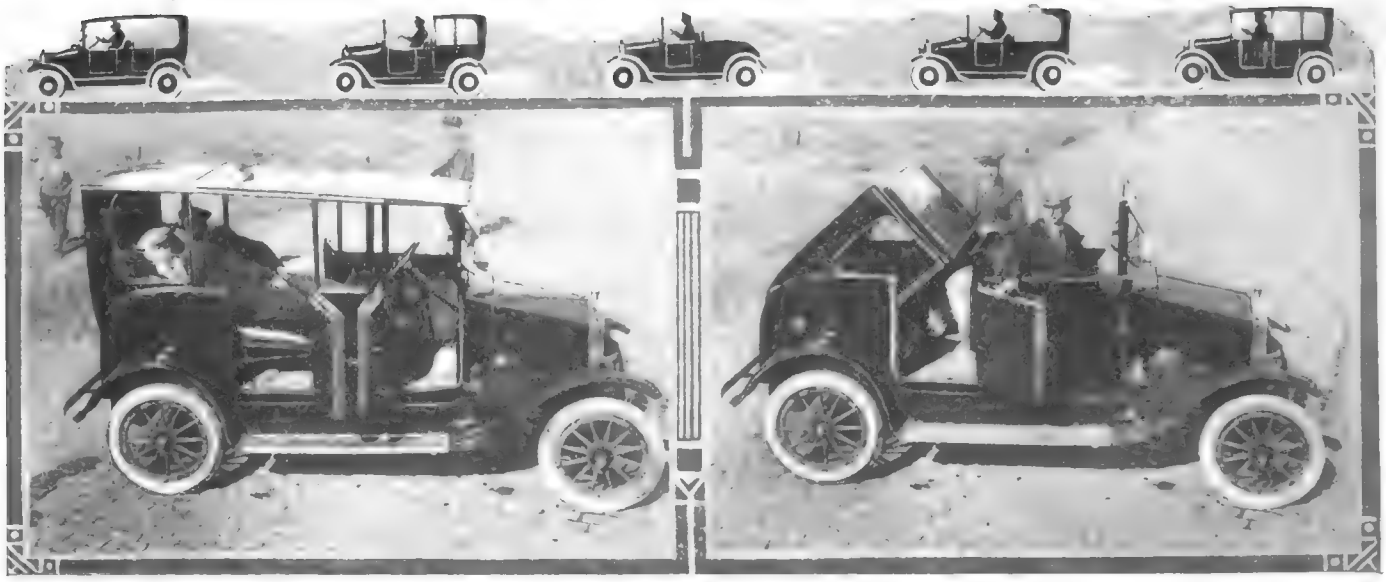
To many people, their long, narrow tails may seem of no use, but they have proved very valuable in procuring food. Rats have been known to help themselves to oil by holding on to some convenient support by the side of the bottle and then dipping their tails into the oil and thus extracting it.



Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Four Automobiles in One



We Have Often Entertained an Idea in Our Minds of a "Perfect" Automobile Which Can Be Changed by Pushing a Button or Two into Almost Any Type of Car We Might Happen to Desire—a Fully Closed Car for Rainy or Cold Weather; a Semi-Closed Car for the Spring and Fall and an Open Car for Summer Motoring. Mr. John J. McGuire Has Beat Us to It, However, and the Accompanying Photographs Show But Two of the Many Possibilities Available to the Owner of a Car Constructed Along the Lines of His Design. He Even Has a Folding Bed as Shown at the Left, While Some of the Other Possibilities Are Shown in the Miniature Machines at the Top of the Photographs.

JOHN J. McGUIRE is the inventor of a convertible type of body that is the limit of versatility; for less than a minute is required to change it to a limousine, an open touring car with victoria top, a coupe, and an open runabout.

In addition to this, a hinge on the back of the front seat can be let down and with the front and rear seats forms a snug bed. Its owner when touring need never worry about a shortage of hotel accommodations for he carries with him quite comfortable sleeping quarters.

Mr. McGuire is in business in New York City and the evolution of his idea arose from the apparent necessity of keeping two automobiles, one as a family touring car and one to get him and his brother, Mr. Bernard McGuire, back and forth from their place of business. He began to ask himself why it would not be possible to combine the two uses by having a body which would serve his business requirements and yet be available on occasions for family use also. His present design is the result of about two years of planning and work along this line.

Mr. McGuire is a practical coach builder by occupation, having learned his trade thirty-five years ago in the town of Longford, Ireland, in the days when coach building was an art, requiring the most careful and skilled hand-work. His present model naturally enough reflects the influence of the custom coach builder.

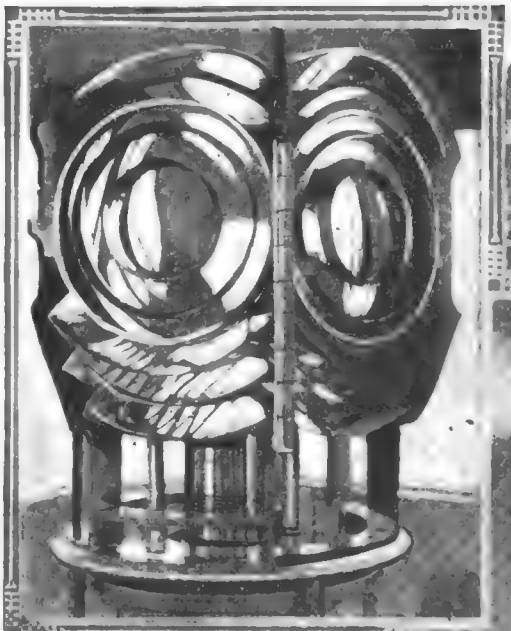
In this connection it is worthy of note that the construction of the windows comprises a separate and entirely new invention and differs from the type now in use in that the windows cannot be opened from the outside.

Mr. McGuire's car, which is mounted on a Ford chassis, took about eighteen months to complete from the day the first plans were drawn, being done in spare moments.

Mr. McGuire points out that no rack for spare tires is necessary, as they may be kept concealed under the rear seat, locked and secure from theft. He claims that his invention may be used on any chassis.

Giant Lighthouse Lenses

THE accompanying two photographs show interesting views of the famous "Robbins Reef" Lighthouse and the powerful glass lenses which throw the giant pencils of light thru the inky blackness of night. The life of a lighthouse keeper or his family, if he happens to be a married man, is one of the lonesomest in the world, as sufficient food and fuel supplies are usually kept on hand to last a month or so. Most of the big lighthouses thruout the world today are illuminated by powerful electric lamps, either of the arc or incandescent type. Some of the lighthouse electric lighting plants comprise a gasoline or other engine driving a dynamo and this is operated thru the night when the lamps are in use, the current being taken directly from the dynamo.



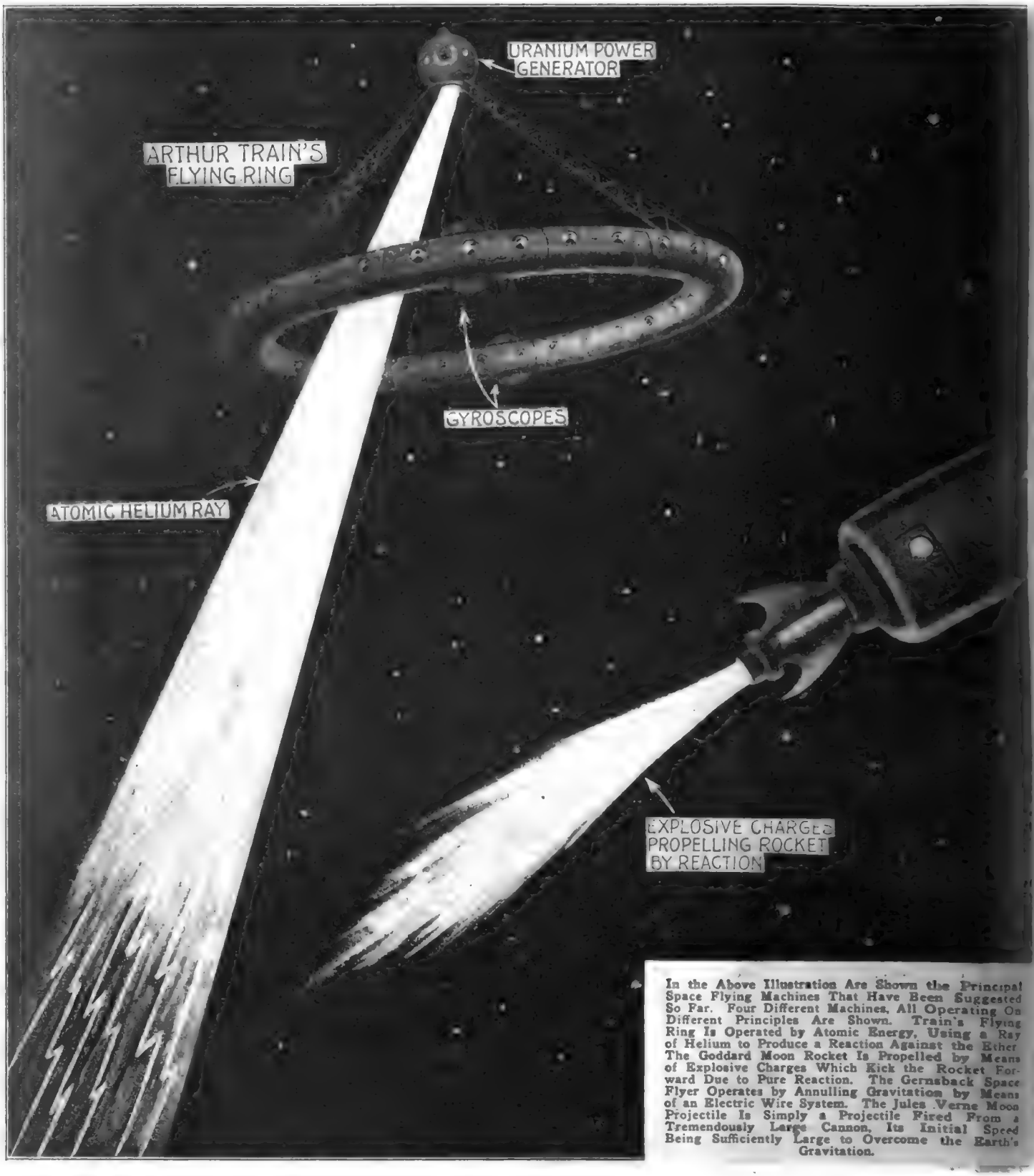
The Famous "Robbins Reef" Lighthouse at Right. The Small Boat, by Means of Which the Lighthouse Keeper and His Crew Visit the Mainland, Is Shown Hanging from Its Davits. The Life of a Lighthouse Keeper Is a Lonesome One as It Frequently Occurs That They Do Not Visit the Mainland for Perhaps One to Three Months or More

Photo at Left Shows the Fresnel Lenses Thru Which Are Flashed the Powerful Electric Searchlight Beams from the "Robbins Reef" Lighthouse to Aid Marines in Guiding Their Ships Around the Reef. Some Lighthouse Lamps Are Operated with Acetylene Gas, But Most of Them Are Electrically Operated at the Present Time.

There are lighthouses having more elaborate electric plants equipt with a storage battery which can be charged one or more times a week as the occasion may require, and the lamps then derive their current from the storage battery at night, the engine and dynamo being operated during the daylight hours to charge the battery. Those who live near seaports and have ever seen lighthouses in action at night have probably noted the different ways in which the light beams are used to signal which particular lighthouse one is looking at. There are several novel ways in which these code signals are arranged. Sometimes the light swings around in a complete circle, while in other cases it only shows its flashes in an angle or half circle, when it is situated on the shore of a harbor.

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



In the Above Illustration Are Shown the Principal Space Flying Machines That Have Been Suggested So Far. Four Different Machines, All Operating On Different Principles Are Shown. Train's Flying Ring Is Operated by Atomic Energy, Using a Ray of Helium to Produce a Reaction Against the Ether. The Goddard Moon Rocket Is Propelled by Means of Explosive Charges Which Kick the Rocket Forward Due to Pure Reaction. The Gernsback Space Flyer Operates by Annulling Gravitation by Means of an Electric Wire System. The Jules Verne Moon Projectile Is Simply a Projectile Fired From a Tremendously Large Cannon, Its Initial Speed Being Sufficiently Large to Overcome the Earth's Gravitation.

Flying In Space

By H. GERNSBACK

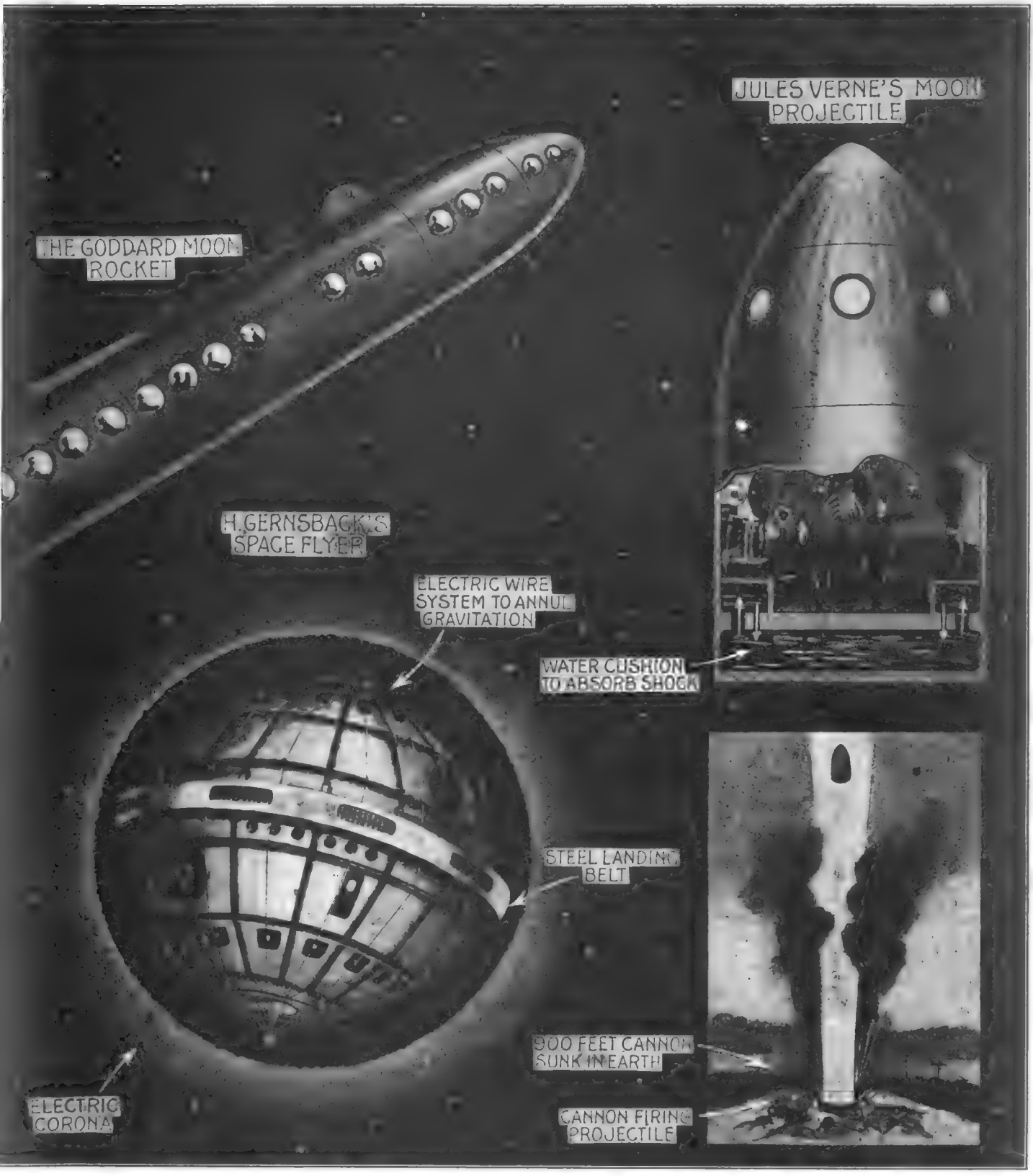
TWENTY-FIVE years ago mechanical flight was discussed seriously by scientists all over the world. Many scientists of great authority demonstrated mathematically that it was absolutely impossible for a man to fly a machine heavier than air. Eminent men of science sustained this view. Notwithstanding all this, we are flying today at will and we are building airplanes that can rise thousands of feet aloft and transport one hundred people over great distances. As usual our scientists were not correct as to what can or cannot be done.

The next step will be flying not only in the atmosphere, but flying in space where there is nothing to sustain a machine and where propellers and planes are no longer of use, because where there is no air there can be no mechanical flight as we know it today.

The full thickness of the earth's atmosphere is roughly speaking about 500 miles. This takes in the densest layer from the earth's surface to the outer space where there is an absolute vacuum, but our atmosphere proper is probably not thicker than

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN


JULES VERNE'S MOON PROJECTILE
THE GODDARD MOON ROCKET
H. GERNSBACK'S SPACE FLYER
ELECTRIC WIRE SYSTEM TO ANNUL GRAVITATION
WATER CUSHION TO ABSORB SHOCK
STEEL LANDING BELT
900 FEET CANNON SUNK IN EARTH
ELECTRIC CORONA
CANNON FIRING PROJECTILE

30 miles. After this distance the rarification becomes extreme. All of this, however, should not deter us from attempting to fly in space. To those who say it is impossible for a body to float in space and in vacuum, let them look at the moon or at any of the stellar bodies, and he will find that these bodies indeed float very nicely without any support whatsoever. This is, of course, due to universal gravitation, but for the moment this need not concern us.

How then can we fly in space? There are several vital points that must be considered. The main point is the earth's gravitation that holds all bodies chained to it. Take a balloon for instance. As soon as the gas gives out, the balloon must come down due to the earth's gravitation; the same thing is true of an airplane which falls or must glide down as soon as the propeller stops. If directional flight at will in space ever becomes assured, it will be absolutely necessary that we first master gravitation, or otherwise annul its effects in some way. Just how this can be accomplisht we of course do not know exactly today, altho there have been several attempts made to conquer the baffling forces that hold all objects to the earth.

The writer has stated many times in his past writings that gravitation is conceded to be an electrical effect today. If this is so, then sooner or later we will find a way to counteract gravitational force by electrical reaction, and when this happens, it will be a simple thing for us to build a machine that by means of electricity overcomes gravitation in a similar manner to a railroad engine overcoming friction by furnishing enough power to dispose of the latter. This is what makes a train move.

One of the earliest and now historical methods proposed for a machine to travel into space was the well-known moon projectile invented by the fertile brain of Jules Verne. He imagined a huge cannon sunk 900 feet into the earth. It required 400,000 pounds of gun cotton to fire the 20,000 lb. aluminum projectile which contained three travelers. The details of this invention were described in his well-known book

Digitized by Google

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

"From the Earth to the Moon." Scientifically this idea is absolutely sound, and if we actually would build a cannon as imagined by Jules Verne, and firing a projectile such as he described, the initial force given the projectile would be sufficient to overcome the gravitational pull of the earth and the projectile would leave the earth never to return. This is a condition fully realized by all artillerists. Given a cannon which fires a projectile whose initial speed is 12,000 yards a second, this projectile will fly out into space never to return. The passengers probably would not survive the shock, but that need not concern us here. Of course this idea was purely fanciful, and the great trouble with it is that there is no means of "navigating" such a projectile. Once out in space it becomes subject to various gravitational effects. If it came within the direct influence of the moon, for instance, it would be drawn toward the surface where it would be smashed to pieces in an instant. If, on the other hand, it would not come under the direct influence of a stellar body, it would roam around the universe for all time until finally struck by meteors or some other body.

In 1915 the writer publisht in the June issue of the "Electrical Experimenter" a machine to fly in space and he gave it the name of "Space Flyer," under which name machines of this kind have now become known. The writer's idea was to use a sphere some 75 feet in diameter which contained all the different machinery and apparatus to navigate and operate the flyer. The underlying idea was to have the whole exterior of the machine criss-crost with an electric wire system, similar to a radio station. These wires radiate over the surface of the machine from the two "poles"; the wires are insulated from the metallic shell of the flyer. The proposal was to use an electric current of a peculiar wave action, which was to annul gravitation electrically. The machine was steered very simply by switching in or out various sections of the wire system. For instance, if the machine was to leave the ground all that was necessary was to switch on the wires facing the ground, while the part pointing towards the sky was not to be electrified. A reaction would immediately set in and the machine would naturally rise as there was no gravitation to hold it back. If the machine approached the moon or a planet, the same electric current was brought into play again, and the retarding motion set up so that the flyer would not smash itself against the face of the heavenly body. There was a steel landing belt provided on which the machine was to roll upon landing. This was necessary otherwise the wire system would be destroyed.

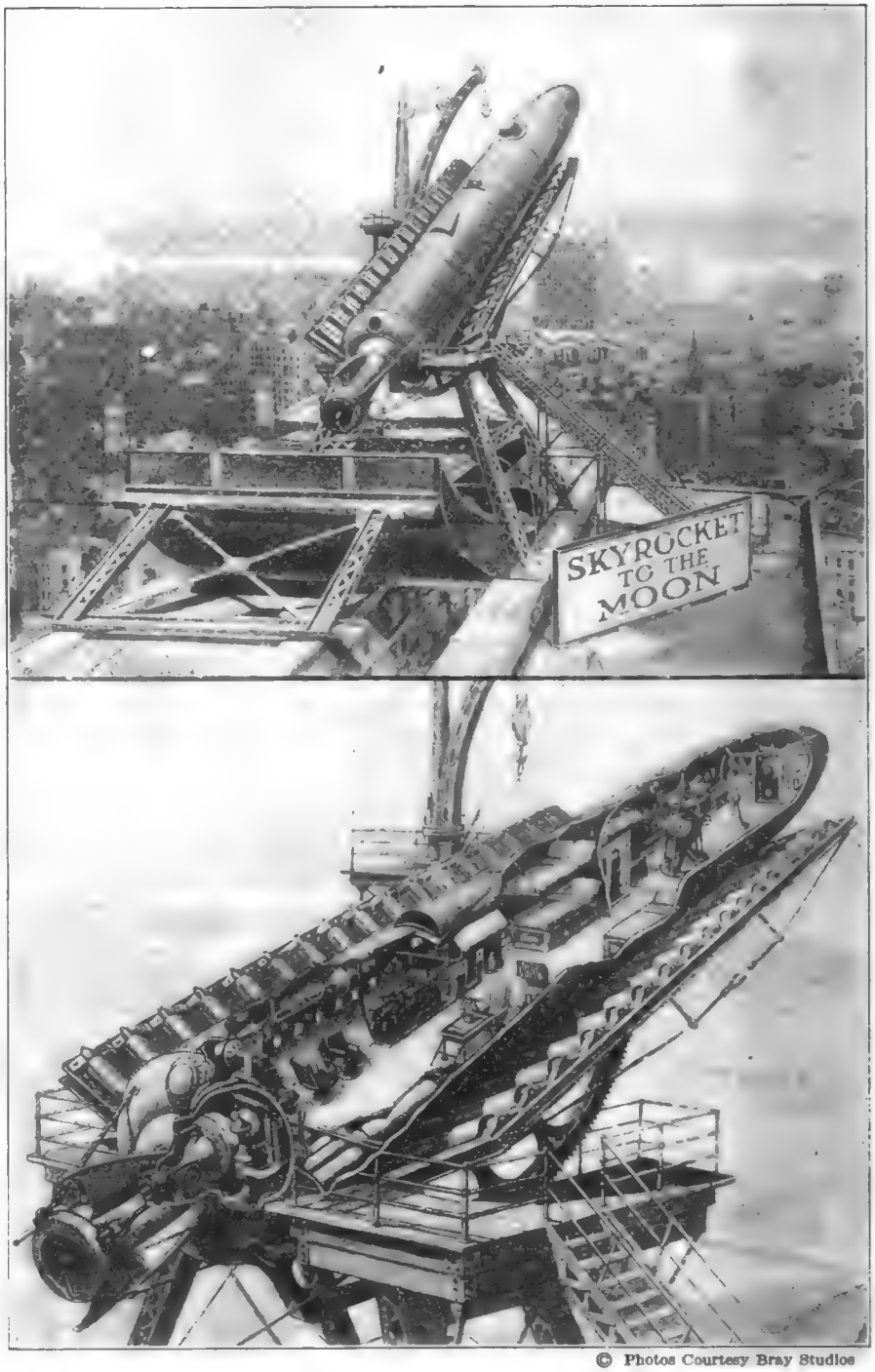
Another idea is shown in Arthur Train's "Flying Ring" publisht in 1917 in his book "The Man Who Rocked the Earth." This also was a fanciful machine and was propelled by atomic energy. The flying ring had a sort of tripod mounted upon it and at the top there was a uranium power generator which gave forth a disintegration ray of great power. This ray striking either the earth, atmosphere or the ether in space would naturally set up a reaction, lifting the ring. The direction of the machine was of course controlled by this ray. The flying ring also could be steered sideways by means of gyroscopes contained in the interior. This idea is perfectly feasible if we ever can make use of atomic energy.

The latest newcomer in space flying machines is Dr. Goddard with his now famous moon rocket. We have already described Dr. Goddard's rocket in our Feb. 1920 issue of the "Electrical Experimenter," where the detailed description of the principles can be found. Dr. Goddard's idea is sound and there is no question that it is possible to send such a rocket out into space. If we take the experimental rocket of Dr. Goddard and magnify it so that it can carry a number of people we will get a machine similar to the one shown in our illustration.

The Goddard rocket operates by explosive charges which emerge from the end of the rocket and the propulsion is accomplisht merely by reaction. It makes no difference whether these explosive charges occur in the atmosphere or in free space; the action is always the same. As a matter of fact, in free space and in a vacuum the kicking reaction of the explosive charges will propel such a machine much faster than thru an atmosphere where the air resistance tends to retard it. Not only this, but once the rocket leaves the gravitational influence of the earth, a much smaller explosive charge will propel the rocket at prodigious speed.

The matter of steering such a rocket is not a simple one and must be worked out very carefully. It would be necessary to have outlets for the explosive charges directed away from the machine at right angles, preferably at the lower end and at the bow of the machine. These explosive charges would be imperative whenever it became necessary to steer the machine to the right or to the left, to turn it about, or for landing purposes. It would not be a simple task to control such a machine by means of these charges, and it would be a ticklish business for instance to affect a smooth landing upon the surface of the moon. While of course it is not impossible to accomplish this, the matter of firing the

(*Continued on Page* 1355)



© Photos Courtesy Bray Studios

"All Aboard for the Moon"—May Not Sound So Strange to Our Ears, Fifty Years Hence. Perhaps Even Sooner the Goddard Rocket Will Have Been Perfected and Made Safe Enough to Carry Passengers Across the Intervening Chasm of Interstellar Space to Our Neighbor the Moon. The Interior Arrangement of the Passenger-Carrying Rocket Is Here Illustrated.

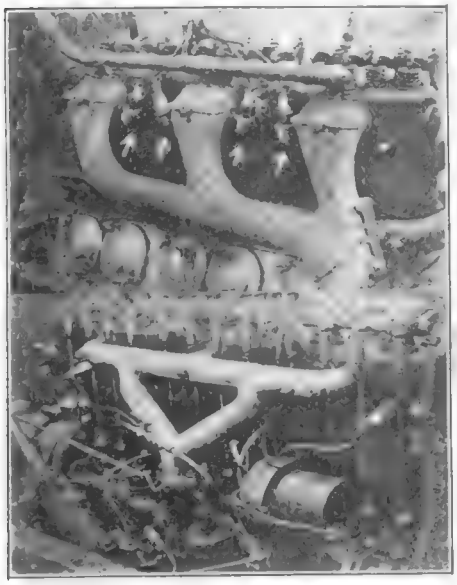
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

MOTOR HINTS

FIRST PRIZE $25.00.

"A REMEDY FOR DIRTY SPARK PLUGS."

On some of the older models of cars great trouble is often experienced due to the continuous fouling of the spark plugs.



Improving Operation of Engine When Spark Plugs Foul and Oil Up Badly by the Simple Expedient of Placing the Plugs in Male-Female Elbows. These Can Be Purchased At Any Plumbing Shop.

The main cause of this difficulty is their position. On a great many cars the plugs sit horizontal instead of vertical, allowing the oil and carbon to collect very readily.

Obtain as many male-female pipe "ells" as there are spark plugs. Next remove the plugs from the cylinders and replace them with the ells, turning them so the mouth of the ell will face up. Now screw the plugs into the ells and connect up.

As will be seen from the photo, it was only necessary to change the middle four, as the first and sixth never fouled.

I found the plugs were perfectly clean a year from the time I changed them.

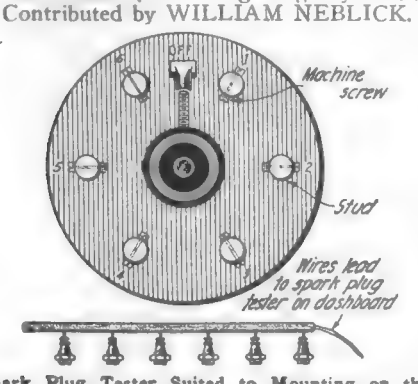
Contributed by

ORAN T. McILVAINE.

SPARK PLUG TESTING DEVICE.

This spark plug testing device is used on the dash-board when the engine is running. In the event that one, two or more of your spark plugs are not firing properly, simply turn the knob on the spark plug tester while the engine is running, and it will show you by the numbering of the studs, which one is out of order, without getting any shocks.

Contributed by WILLIAM NEBLICK.



Spark Plug Tester Suited to Mounting on the Dash-board.

$50.00 IN PRIZES

Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

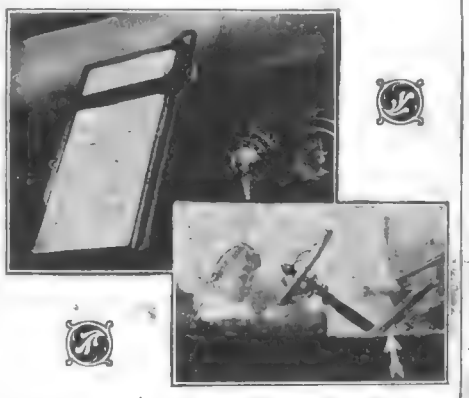
FIRST PRIZE.....$25.00
SECOND PRIZE..... 15.00
THIRD PRIZE..... 10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

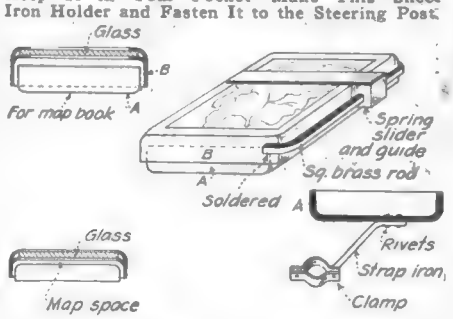
SECOND PRIZE $15.00.

INDEX ROAD GUIDE AND MAP HOLDER.

The accompanying photo and diagram show my index road guide and map holder as applied to my "flivver," and on which I am endeavoring to obtain a patent. This device brackets to dash or steering column or may be read from the hand.



Don't Hold the Road Map on Your Lap or Keep It in Your Pocket—Make This Sheet Iron Holder and Fasten It to the Steering Post.



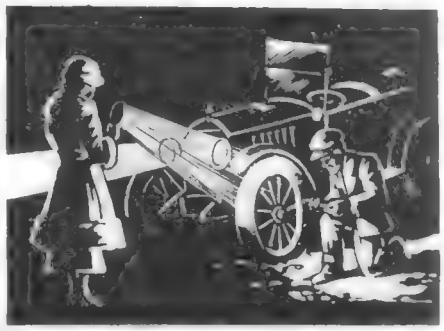
The index finger is movable and is spring clamped to guide rod, remaining in position where set. Read above the finger going from bottom to top of face—read below finger going from top to bottom. It will hold a single sheet map or an open book 1½" thick (practically all commercial maps publisht for road guide purposes). It consists of two telescoping pans, one glass bottomed, suitably clamped together as desired.

Contributed by P. C. FISH.

THIRD PRIZE $10.00.

MIRROR SERVES AS "TROUBLE LAMP."

I wish to enter your "Motor Hints" contest and I enclose sketch showing the way I have repaired my car at night on the road, with a mirror to reflect the beam from the headlight under the car. By turning the headlight to one side I could



The Simplest Trouble Light—Simply a Hand or Other Mirror Used to Reflect the Headlight Beam Rearward.

reflect the light on the rear wheels. The mirror on the car can be used with good results.

Contributed by

HARRY E. CONRAD

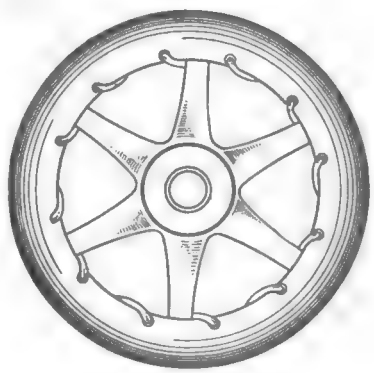
A SPARE TIRE FOR EMERGENCIES.

Many motorists have met conditions where it seemed advisable necessary to "limp in on a flat," as the saying goes. When the spare tire has been used and there is no time to bother taking the tube out and making repairs the idea described here will be of service.

In addition to the regular spare, carry an old shoe, somewhat smaller than the regular equipment. The sides of this shoe should be perforated with holes as shown in the sketch and several old treads slipt inside it. When all the spares are used and a tire goes flat simply remove the flat tire, slip the old shoe over the wheel rim, lace it in place and go ahead. The rim will not be damaged, the going is not bad and it will prevent rim cuts on a good tire were you to run on it flat. The old shoe can be carried without difficulty and will be found mighty handy at times.

Contributed by

THOMAS W. BENSON.



In Addition to the Regular Spare Shoe, Carry An Old Shoe Along. This Shoe Should Be Perforated With Lacing Holes As Shown.

Digitized by Google

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Popular Astronomy

By ISABEL M. LEWIS, M. A.

of U. S. Naval Observatory

THE earth is inconceivably old. The most reliable method of determining its age—that of computing from the present amount of radium and lead in the older rocks the time necessary for the disintegration of the original uranium content of the rocks into these elements—indicates that a period of nearly two billion years has elapsed since these rocks were formed. How long a time the earth was in existence as an individual member of the solar system prior to that date is not known, but it is believed to have been fully as long as the interval that has elapsed since the formation of these earlier rocks.

More recent knowledge of the condition of the earth's interior has altered radically our earlier ideas on the subject. Instead of an intensely hot, liquid interior encased in a cooled, hardened and contracting surface crust we now know that the earth has a highly elastic and rigid metallic core of great density, largely magnetic iron in composition.

The original earth-mass has more likely been increased by the addition of adjacent masses than decreased in size by contraction under gravity from a nebulous mass of great volume and low density.

All of the inherent heat of the earth originates, it is now believed, in a comparatively shallow shell of radio-active rocks less than one hundred miles in thickness instead of within its central core which probably has a temperature approaching the absolute zero of space.

We cannot consider the question of the origin of the earth without reference to the origin of the solar system. That all the planets as well as the planetoids originated from a common parent-mass is not seriously questioned. All of these bodies revolve about the sun and rotate upon their axes in the same direction—from west to east. Moreover, all of the planetary orbits lie very nearly in the same plane and are nearly circular in form.

The orbits of the planetoids are more elliptical and more highly inclined to one another than are the orbits of the planets, but on the *average* they are neither very elliptical nor very highly inclined to the planetary orbits.

The Origin of the Earth

The sun rotates upon its axis in the same direction in which the planets rotate and perform their revolutions and the orbits of the planets are inclined at small angles *to the plane of the sun's equator.*

Fig 1. Illustrating the Theory of Ejection of Streams of Matter from the Sun Under the Attraction of a Passing Sun. The Dotted Lines Show the Paths Taken by Ejected Particles (Planetesimals) After the Secondary Sun, Has Past By. The Continual Ejection of a Number of Streams Would Produce Formations Similar to the Great Spiral Nebulae, tho Much Less Extensive. This Illustration Shows Clearly How the Planets Might Have Been Formed by the Whirls of Planetesimal Particles; These Concentrated Groups of Particles Which Form, Gradually Becoming More Dense Until They Contracted Sufficiently to Form a Solid Sphere Such As Our Earth.

These facts are all significant and cannot be overlooked in formulating a theory to explain the origin of the planetary system in general and of the earth in particular. Presumably the planets and planetoids formed at one time a part of a central body which rotated on its axis in the direction in which they now revolve about the sun.

When and by the operation of what force, external or internal, they were separated from this central body is the question.

THE LA PLACE "NEBULAR HYPOTHESIS" THEORY.

In 1796 La Place advanced his celebrated *nebular hypothesis* to explain the origin of the solar system. It was received with favor both by scientists and laymen and in a short time was almost universally accepted as closely approximating to the truth.

According to the nebular hypothesis the solar nebula from which the planetary system was formed, originally extended at least as far as the orbit of Neptune and rotated slowly in the direction in which the planets now revolve. As it lost heat by radiation and contracted under the gravitation of its parts its rate of rotation necessarily increased. When the centrifugal force at the equator equalled the central gravitational force a ring was left behind by the contracting nebula. Such a ring would not be absolutely uniform and would break at some point and gather into a planetary mass under the gravitation of its parts. This planetary mass would abandon rings in turn and these would break up to form satellites. Successive rings were abandoned at intervals by the solar nebula at the present distances of the planets from the sun in the manner described above until the original solar nebula had contracted to its present size.

The rings of Saturn were supposed to be the single example remaining of this process of forming planets and satellites from a *contracting nebulous mass.*

The La Placian hypothesis attempted to explain why all the planets and their satellites revolve in the same direction in which the sun turns on its axis, in nearly circular orbits and nearly in the same plane. At the time it was advanced it appeared to be in accord with all the facts then known regarding the solar system.

The planetoids with their interlacing and in some instances highly inclined and elliptical orbits were then undiscovered. It would have been impossible for them to have been formed by the abandonment of successive rings.

The constitution of Saturn's rings was unknown at this time; also the fact that the moonlets of the inner ring revolve about Saturn in *half* the time required for the planet to turn on its axis—another impossibility under the nebular hypothesis.

The satellites of Mars were not discovered until many years later, as well as the retrograding satellites of Jupiter and Saturn, all presenting difficulties in the way of accepting the nebular hypothesis without radical changes. Attempts, mostly unsuccessful, have been made from time to time to make these exceptional cases fit in with the requirements of the nebular hypothesis.

The theory of the origin of the sun's heat through contraction advanced by Helmholtz, appeared to give considerable support to the theory of La Place but the mathematicians got to work and showed that the amount of heat that would be furnished by the contraction of the sun from beyond the orbit of Neptune to its present dimensions would be sufficient to supply

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

heat to the earth at the present rate for only twenty-five million years, a period far too brief, the geologists and biologists found, to cover all the vast cyclical changes that are known to have taken place upon the surface of this planet since its surface crust was formed. Evidently gravitational contraction is by no means the only or even the chief source of the solar energy.

The mathematicians, moreover, did some more figuring and showed that under the suppositions of the nebular hypothesis the hypothetical solar nebula, at the time it extended beyond the orbit of Neptune, must have had a moment of momentum *two hundred times* as great as that of the present system, though owing to the principle of the conservation of moment of momentum the two should be *equal*.

They also showed, indisputably, that it would have been impossible for successive rings to have been abandoned at certain definite intervals by a contracting nebula and granted that if a ring *could* have been abandoned it would have been impossible for it to condense into a planet, since tidal forces due to the sun would offset the gravitation of its parts.

When La Place advanced his famous theory it was, "with that distrust which everything ought to inspire that is not a result of observation or of calculation."

Were La Place living today he would be, we believe, the first to abandon a theory that is now known to be in accord neither with observation nor calculation.

Being deprived of a theory that has served to explain the outstanding features of the solar system more or less adequately for one hundred and twenty-five years, astronomers are seeking in the light of recent observations and discoveries to formulate a satisfactory theory of the origin of the solar system.

THE PLANETESIMAL THEORY

In the planetesimal theory of Chamberlin and Moulton and the recently suggested theory of the well-known English mathematician Jeans, *a second sun passing close to our own sun is assumed to have been the cause of the origin of the planetary system.*

The effect of the close approach of such a sun would be the ejection of a stream of matter from our sun as we may term it, in the direction of the passing body and also in a diametrically opposite direction, according to the *planetesimal theory* (see Fig. 1.) This ejection would be continuous as long as the stars remained near one another, the height attained by the ejected stream decreasing as the passing star receded. The result would be the formation of a *spiral nebula* in which the motion of the ejected particles, — planetesimals — would be across the spiral arms, toward and away from the passing star. After the sun had receded so far as to have no further effect upon these ejected particles they would revolve about the sun in more or less elliptical orbits which would gradually be reduced to nearly circular forms by repeated collisions between planetesimals. *Larger nuclei* would be formed and these would gradually sweep up smaller fragments and become the planets of the present system. Smaller nuclei in the vicinity of larger ones would become their satellites and in the course of many millions of years all of the larger fragments would be swept up by the planetary nuclei and their satellites—leaving only the asteriods, comets and meteors as survivors of the original spiral system.

It must be borne in mind that a spiral nebula formed by the close approach of two suns would resemble in *form only* the great spiral nebulae that are known to exist by hundreds of thousands in the heavens. These are far too extensive to form anything so small as a single solar system but would condense into systems composed of many suns,—either galaxies or star clusters.

Jean's suggested theory of the origin of the planetary system differs in its details from the above, though a passing sun is assumed to be the disturbing force that causes the ejection of a stream of matter which condenses to form the planets and their satellites. The origin of the inner planets is left greatly in doubt, however, and it is stated that the system which interests us chiefly—the earth-moon system, is the one about which it is most difficult to arrive at any definite conclusion. Our own sun, it is assumed, was dark and cold, of low density and with a diameter about equal to that of Neptune's orbit at the time of the catastrophe which is placed at some 300,000,000 years ago. In Jean's words, " . . . The time for arriving at conclusions in cosmogony has not yet come—(and it must be left)—to future investigators armed with more mathematical and observational knowledge than we at present possess to pronounce a final decision."

However, since La Place advanced his celebrated nebular hypothesis, great advances in astronomy have been made, and man is in a better position to theorize on this fascinating problem today than he was one hundred and twenty-five years ago.

All such theories must necessarily be regarded as working hypotheses only, to be discarded or modified as our knowledge and understanding of the laws of the universe increase. No theory can ever be regarded as final or perfect.

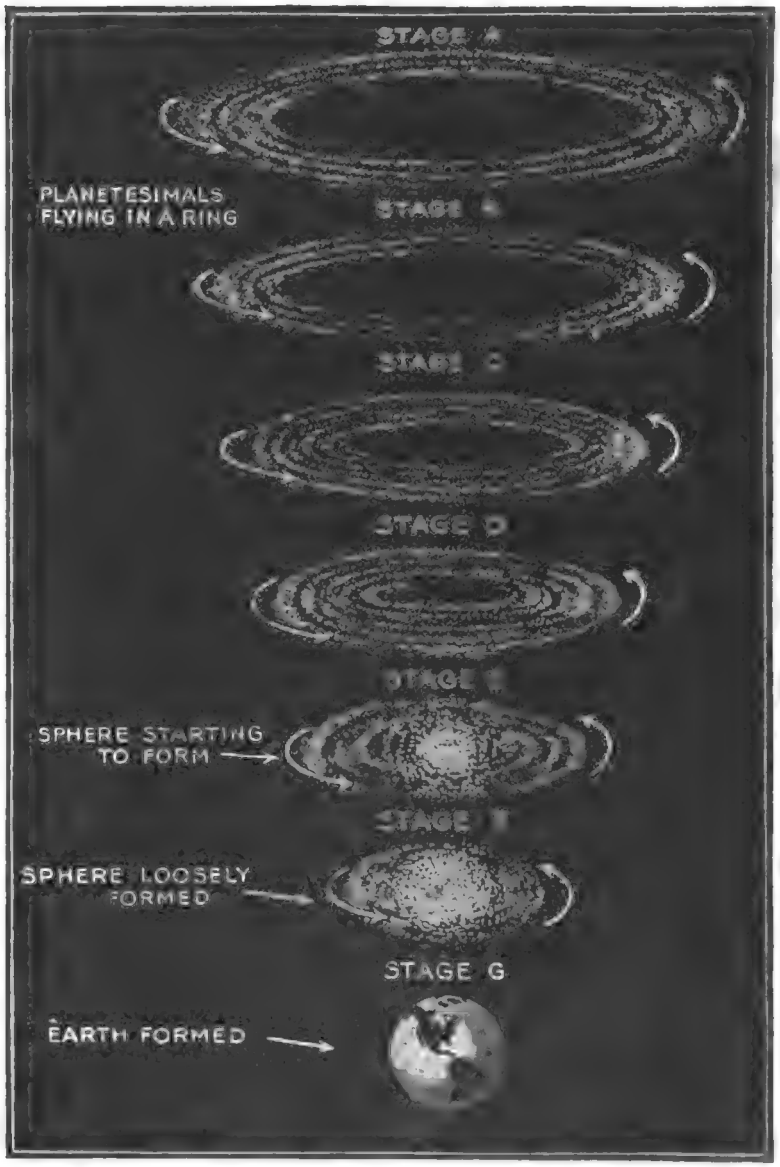
The discovery of radio-activity furnishes us with new material for new theories. The sun and the planets may be and probably are far older than we ever dreamed was possible. It is no longer necessary or reasonable to assume that a greatly extended solar nebula once existed and supplied the planets with heat through gravitational contraction or to place a time limit upon the period required for the formation of the planets and their satellites, that is not in accord with the requirements of other sciences.

We also know today that there exists within the sun powerful repulsive forces, which even under present conditions eject gaseous matter to heights of five hundred thousand miles or more with a velocity of over two hundred miles per second. Small changes in the velocity of ejection produce great differences in the height of the ejected columns.

With an initial velocity of three hundred and eighty miles per second, matter would be thrown from the solar surface to a height of fifty million miles. Were the velocity of ejection three hundred and eighty-three miles per second the height of the column would be five hundred million miles, while a further increase in the initial velocity would send matter away from the sun never to return.

Novas, or temporary stars are not considered such rare phenomena today, as they were even twenty or thirty years ago. By the aid

(*Con. on page* 1326)



This Illustration Shows Vividly How a Planet Such as Our Earth Might Have Been Formed, Under La Place's Theory from the Whirlings of Planetesimal Particles. The Ring of Particles Acted Upon by the Gravitational Pull of Each Individual Particle, Gradually Contracts Until the Ring Itself Becomes of Smaller Diameter and More Dense, Breaking and Culminating Into a Semi-Dense Ellipsoid and Finally Into an Approximate Sphere Resembling the Present Form of Our Earth.

Digitized by Google
CC-BY-NC-SA
Generated on 2026-04-17 19:21 GMT / http://hdl.handle.net/2027/uiuo.ark:/13960/t3ww7ww2k
Public Domain in the United States, Google-digitized / http://www.hathitrust.org/access_use#pd-us-google
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Movies Shown on Moving Train

A few weeks ago, the passengers aboard a southern railway train were pleasantly surprised when a phonograph was started, a screen rolled down and a movie show given.

Movie shows on trains running at a speed of 60 miles an hour, are quite a novelty, and an innovation which will add greatly to the comfort and amusement of the passengers. In conjunction with the photoplay given, a phonograph furnisht the music; and every hour, the performance of the show was repeated.

Moving Pictures "en route" While Speeding Along on a Moving Train Is One of the Latest Novelties and Pleasures Provided for Railroad Travelers. This Train Is the New Orleans Limited, and Music for the Show Is Provided by a Phonograph.

The pictures were made possible by the utilization of a specially designed generator, and in the opinion of the persons present, the show was an entire success.

Those witnessing the demonstration on the southern railway train were greatly pleased with the show, and exprest a fervent desire for the universal adaptation of this splendid idea, especially on long trips.

Many railway officials are now contemplating the installation of apparatus for furnishing movies en route.

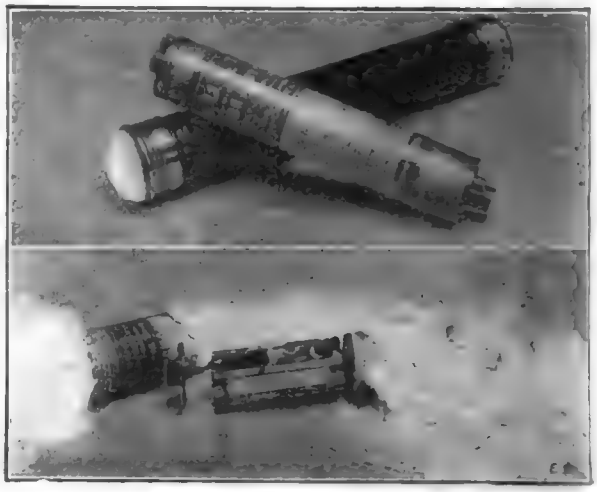
A Storage Battery Flashlight

A new so-called torch accumulator which has recently been placed on the English market promises to take the place of the dry-cell type flashlight battery. It is made to fit the standard two and three cell cases, is equally as light as those fillers, and has the distinct advantage of allowing for a complete recharge within from eight to ten hours after a complete "run down."

The photograph depicts this storage cell in its compact closed position. Cut open and dissected, it discloses great ingenuity and cleverness. A *grooved wooden separator* is filled with the red lead and litharge compounds for the positive and negative plates instead of the usual lead grid; this makes for its extreme lightness. Very little lead, except for the connections, enters into the construction of the battery. One cell is connected in series with the other thru the intercell separator.

When charging, a very small amount of sulfuric acid electrolyte is poured into each end of the battery, it is then connected to the charging circuit with the necessary resistance in series, for about eight hours. Upon removal, the acid is poured out if there should be any in the case or container, and the battery closed up and wiped dry.

This battery does not corrode the case because it is absolutely tight and acid proof.



Making Your Own Records

The new phonograph disc type recorder, here illustrated, is the invention of Mr. C. E. Sanders, and consists of a recorder and reproducer operating on a wax disc, which is placed on any standard phonograph. The recording and reproducing elements are fed across the disc by a feed arm traveling in a metal spiral lying in the center of the disc.

New Disc Phonograph Attachment Enabling Any One to Record and Reproduce Their Own Voice.

Mr. Sanders has succeeded in producing a fluid cleaner, or erasing compound, which softens the surface of the wax and smooths it so that it may be used over and over again from fifty to one hundred times without the usual shaving operation. The record on the wax is of the hill and dale variety, one hundred lines to the inch and runs for about two and one-half minutes. The natural timbre of a voice is perfectly retained, it is said. The records can be played about fifty times from the wax, or they can be made permanent by sending them to headquarters for a small charge to be plated with copper, nickeled and stampt in conventional stock.

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

How Rocks Grow

By WILLIAM M. BUTTERFIELD

RECENTLY a motion picture of a mountain being blown apart by explosives was shown in various metropolitan theaters, probably causing most of those witnessing this thrilling exhibition of gigantic human "destruction" to think that the masses thus separated could never again form any part of solid rock, much less a mountain.

Those not familiar with the development of the stony foundations of the earth often believe rocks are unalterable masses which were created in their present shape at the birth of our globe, a very natural notion that is persistent and not easy to correct.

Rocks have changed in past ages, and have been disintegrated in a slower, less spectacular manner than was shown in the moving-picture display. Rock changes are so slow, in fact, that successive races of men often live their brief lives amid rocks, which as far as tradition and ordinary surface observation go, have never changed their contours.

The "destruction" of rock, as the breaking process shown at the movies, may under the usual understanding be called, —nevertheless, is an essential part of the history of many of the common rocks. All rocks exposed to the atmosphere, to common water, to snow, ice, glacial action and the heat of the sun, and of subterranean temperatures are subject to change; uneven expansion and contraction in the rock mass, or chemical actions may also affect them. Thus mountains may be reduced in part, to boulders, the boulders to pebbles, the pebbles to sand, and the sand to silt. Glaciers do much of this work.

Mountain streams, rivers, glaciers and even the waters of the ocean, convey this detritus and distribute it over large areas, —often thousands of square miles in extent, first as a loose soil of various degrees of fineness from boulders to the finest silt,—the mineral constituents of such soil is supplemented by vegetable and animal life and detritus. In course of time, other deposits are laid down at the bottom of the valleys, lakes and bays, one deposit on top of the other in layers of different kinds. These deposits may then be converted by cosmic force and cosmic time—lapse into rock strata, which often vary largely in composition.

Rocks are composed of various constituents that are practically indestructible, but which admit of many combinations and changes, the most important of their constituents are: oxygen, silicon, aluminum, magnesium, calcium, potassium, sodium, iron, carbon, sulfur and hydrogen. Oxygen in combination with the metal calcium, and with carbon forms calcium carbonate or limestone, and this calcium with sulfur and oxygen forms calcium sulfate—gypsum.

Heat, such as is now exhibited by volcanoes, produces a typical variety of rock (the igneous rocks) and sometimes changes the character of the sedimentary and crystalline varieties. There is still an important element of rock growth and decay very rarely spoken of by geologists, but which could we think be mentioned here; it is the combined work performed unconsciously by the members of the other great kingdoms (animal and vegetable), mankind in this instance included.

Man tears the solid hills apart for building materials or minerals, he levels them to perform engineering feats, to construct water-ways, dams, traction lines, or for various other purposes. Over the entire habitable globe farmers spread on the soil some prepared constituent of rock as fertilizer, and dig up and level the soil in such a state, that water and air can more readily combine these fertilizing elements with the so-called unfertile ones.

So everywhere animals and plants are performing some such work, all of it essentially a part of rock transformation.

Lime in solution in oceans, rivers, lakes and drinking waters is made by animals into shells, corals or bones.

Glacial Action Grinding Rocks to Powder and Forming Boulders. The Streams Issuing from Their Lower Moraines are Opaque and Discolored by Suspended Mineral Matter Produced by the Grinding of the Rocks Under the Mass of Slowly Moving Ice.

An Active Volcano, Showing the Agency Which Has a Part in Forming Plutonic Rocks. What Goes on in the Interior of the Earth Can be Surmised from These Exhibitions of Cosmic Power.

A Mountain Cascade Playing Its Part in Rock Disintegration. Its Action Is Usually Mildness Itself Compared to the Slow Intensive Glacial Processes, but the Action Is Progressive and Noticeable to the Student of Geology.

Level Strata of Rock Undisturbed by Any Changes. As the Strata are Supposed to Have Been Deposited from Suspension in Water, They are Normally Level.

The Bending and Deformation of Originally Parallel Strata. Here We See the Normally Level Strata Thrown Out of Line and Upheaved and Deprest by Various Causes.

The Erosion and Upheaval of Rocks Forming Mountains and Making the Strata Totally Irregular. Here Volcanic and Igneous Action May Come into Play with Accompanying Metamorphosis.

Man's Mining Operations, Where He Performs the Functions of the Mole, Working Formerly Almost in Darkness, Altho at Present the Electric Light Has Enabled the Mine to be Brilliantly Lighted.

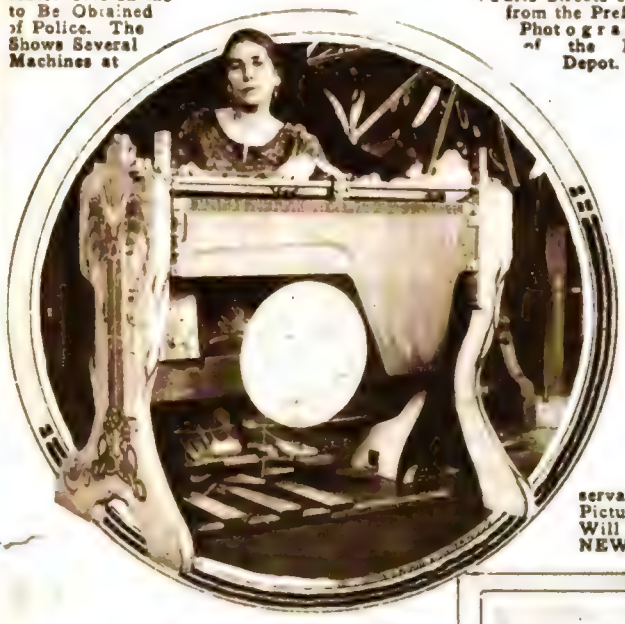
Mining Animal Rock (Coral Rock) that Forms Nearly all of the Island of Bermuda. Some Rock Can be Easily Worked Without Using High Explosives, But Other Rocks Again, Such as Granite, Are Extremely Hard to Quarry.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

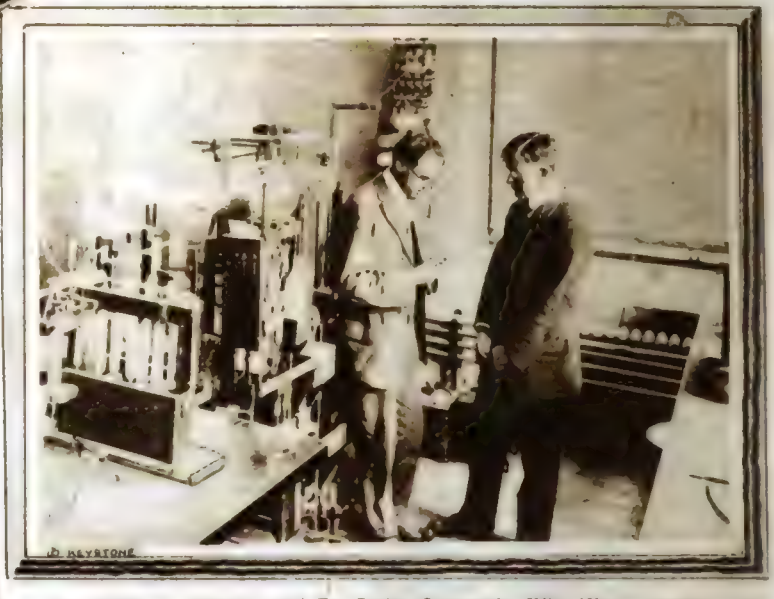
Science

Six-Wheel Motor Bus, Recently Placed in Operation by a Paris Transportation Company. A Fleet of These Machines Has Been Placed in Commission. A Special Permit to Use the Six-Wheel Motor Cars on the Paris Streets Had to Be Obtained from the Prefect of Police. The Photograph Shows Several Machines at the Big Depot.

"Movies" of the Moon Were Made Recently Thru the Great Refractor Telescope at the Yerkes Observatory at Williams Bay, Lake Geneva, Wisconsin. The Pictures Were Made by the International Film Service and Will Be Shown Exclusively in the INTERNATIONAL NEWS WEEKLY.



Mrs. Mary Hallock Greenwalt of Philadelphia, With Her "Nourathar" or Instrument by Which, as One Would Play a Piano or Organ, Lights in the Theater May Be Controlled in an Amazing Number of Ways to Permit Any Expression Desired by the Orchestra Leader, So as to Make the Acting and Singing More Realistic.



Dr. Willis R. Whitney and Dr. Irving Langmuir, Who Were Awarded Distinguished Honors for Important Scientific Research by the Society for Chemical Industry. Dr. Whitney (at Left) Is the Director of the General Electric Company's Research Laboratory and Dr. Langmuir Is Assistant Director.

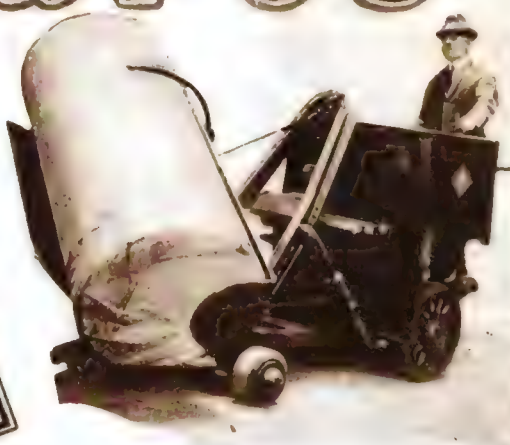
New Type of Telephone Receiver for Long Distance Calling. This Type of Receiver, Which Hooks on to the Ear, Has Been in Use by All the Government Departments of Germany and Found Highly Successful. No Sound but That of the Human Voice Over the Wire Can Creep in Thru the Sides of the Receiver While the 'Phone Is in Operation.

Digitized by Google

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

in Pictures

Before the Towns in This Swedish Locality Become Famous as Winter Resorts, These Places Were Utterly Snowed in. By Means of This Trolley Which Runs from One Resort to Another, and Which Is Equipt With an Efficient Snow Plow, the Road Is Kept Open Even in the Most Snowy Weather.

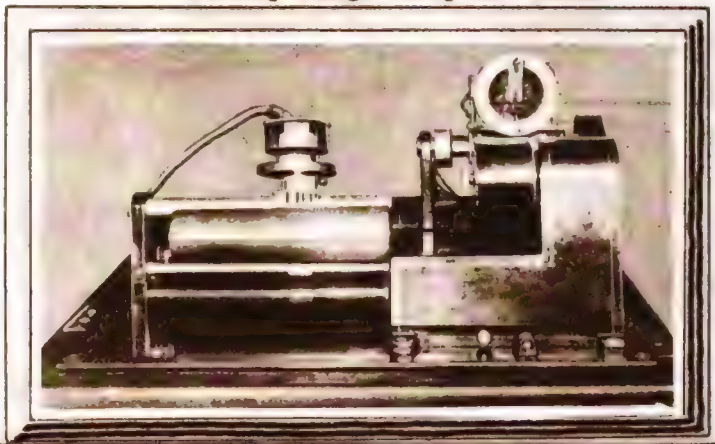


An Ingenious "Apron" Attachment to the Fore end of an Ordinary Electric Truck Has Eliminated the Heretofore Tremendous Labor Necessary to Handle the 800-Pound Rolls of Newsprint Paper. The Truck, or Apron as It Is Called, Picks Up the Heavy Rolls, Carries Them Off and Stands Them on End. The Photograph Above Shows the Ingenious Mechanism at Work.

The Machine Shown Above Shines Your Shoes While You Wait Without Extra Tips. The Machine Here Illustrated Is Fitted with Three Seats and These Three Patrons Can Be Accommodated at One Time. The Electric Motor Driven Brushes First Remove the Dust and Dirt from the Shoes, and After the Polish Is Applied, the Shoes Are Given a High Gloss by the Attendant. One Minute Completes the Process.

This "Telegraphone" Perfected by Mr. Seelan Newman of Berlin, Consists of a Combined Recording and Reproducing Phonograph. It Is Intended for Office and Home Use, and Is Attached to Telephones, Recording Messages During One's Absence.

A New Auto-thief Alarm Device Exhibited at the Chicago Auto Show Attracted Much Favorable Comment. The Alarm Is Enclosed In an Iron Box. No Part of the Machine Can Be Touched Without Starting This Alarm to Ringing. This Prevents the Stealing of Autos. Over 100,000 Combinations of the Locking Mechanism Are Possible by Means of the Keys.



Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

The Love Machine

By CHARLES S. WOLFE

FENNIMORE ript out a surprised oath, and hurled the morning paper to the floor with such vehemence that the sad faced man who stood patiently behind his chair involuntarily bounded backward a foot or two. Such outbreaks on his master's part were unusual.

Muttering unintelligibly, Fennimore addrest himself to his coffee and rolls vigorously. This farce lasted only a few minutes, however, for the young man was past the eating stage. In spite of himself he soon gave over, reluctantly picking up the paper and turning again to the advertisement that had engendered the outburst.

He found the "Personal" column again, and located the offending ad. He read and re-read it, carefully, moodily.

"I offer my personal services to any person who finds his or her love unrequited. Success of your suit is certain if I handle it. George Parsons, 1938 M—— Street."

The words stared mockingly up at him from the printed sheet. For be it known that Fennimore, scion of wealth, accustomed to having his desires speedily realized, no matter what bizarre turn they took, was head over heels in love. Very unfortunately, the object of his affections could not, by any stretch of the imagination, be said to be in the same condition.

Fennimore, paper in hand, rose slowly to his feet, leaving his neglected breakfast to the care of the servant.

"His personal services, eh?" he muttered, "Well, we'll see what they amount to."

So it was that a half hour later, while his chauffeur loafed in the car outside, Fennimore sat in conversation with George Parsons in the M street house.

Parsons, a jovial faced, middle aged man of short stature, honestly privileged to prefix his name with "Professor" and suffixt with Heaven knows how many formidable combinations of letters, leaned back in his chair and regarded his fidgetting visitor genially.

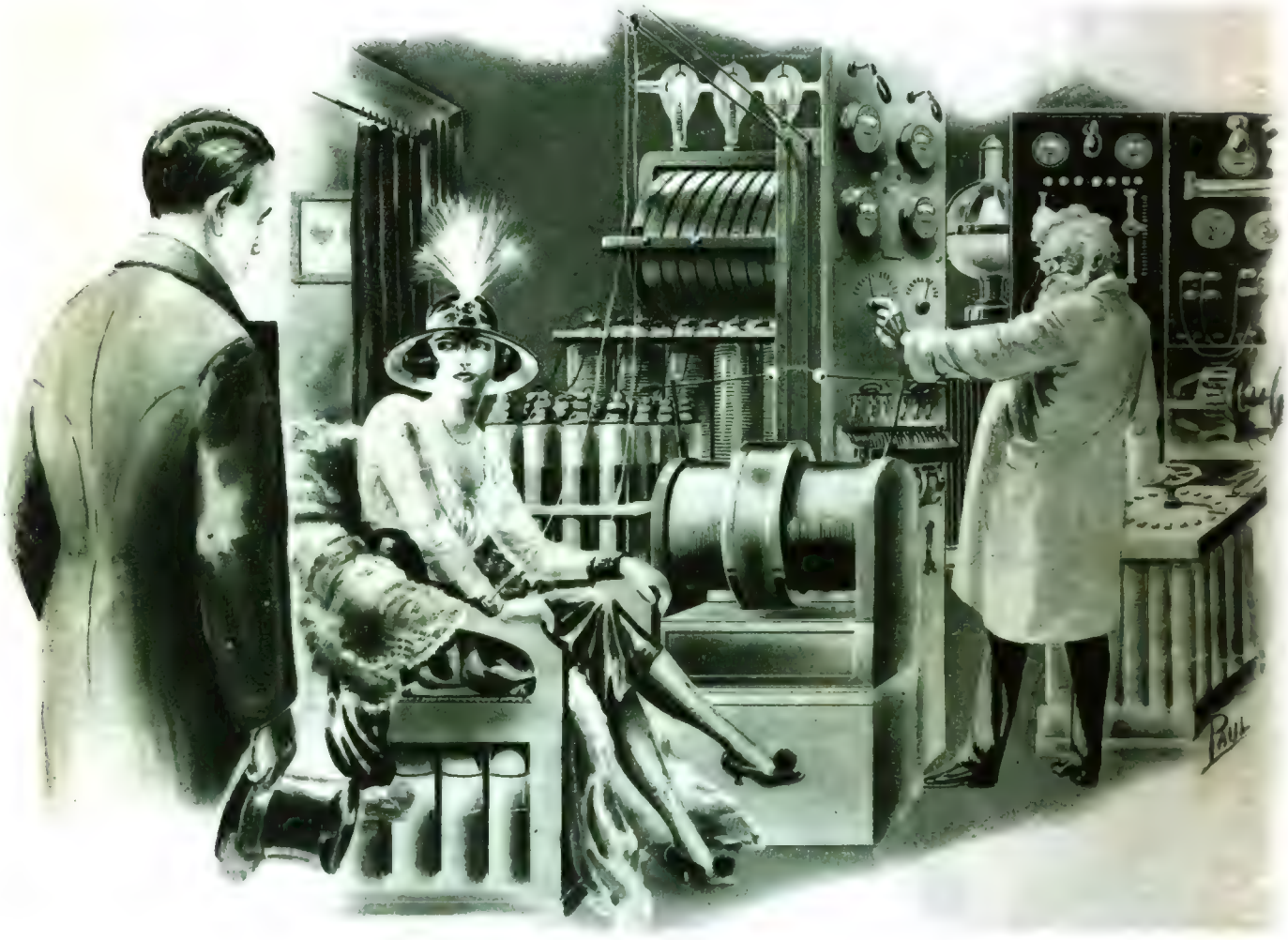
"So you are in love?" he mused. Fennimore glared without replying, a fact which disturbed the placid professor not a jot.

"Does the lady give you no encouragement whatsoever? Have you made no progress at all on your own hook?"

Fennimore's fists clenched and unclenched in the violence of his rage. "Just enough to keep me hanging around the stage door like the rest of the fools in this town," he flung out bitterly, "I'd give a million dollars to see one symptom of real affection in her whole body."

Parson looked pleased. "Oh, we won't be that steep," he said, assuringly, "Ten thousand will see you out easily."

If looks could kill, Parson's hour had struck then and there. "You're damned mercenary about it," snarled Fennimore, "That detail could have waited 'till later."



© 1921 by Science and Invention

"'.....and If You Were a Hundred Times Better Looking Than You Are, I Would Not Marry You If You Were the Last Man on Earth....' Prof. Parsons snapt on a Switch and Grinned At the Disheartened Millionaire. 'You Young People Think That Love Is a Question of Good Looks, Circumstances and Mutual Attraction,' Said Prof. Parsons. 'You Have Fallen Into the Common Error of Mistaking the Effect for the Cause. No two People Will Be Attracted to Each Other to Any Degree,—Far From Sufficient to Love,—If Their Natures Are Not Tuned Properly for the Occurrence of the Phenomenon'....."

"Just enough to keep me coming thru with the supper parties after the show.

Parsons was quite unmoved. "It is best that we understand this part of the matter right from the start," he demurred, firmly, "I'm a scientist, young man, but I am not wedded to my studies. The Almighty Dollar is no revolting spectacle to me."

"And what do you propose to do to earn this sum?" challenged Fennimore, sulkily.

"I propose to make this——er—— actress of yours the most docile, obedient, adorable and loving young bride that you ever laid eyes on."

(Continued on page 1357)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Auto Wrinkles

A Stubborn Lamp Rim Will Come Off Easily Without the Damage Done by Tools If Friction Tape Is Wound Around the Rim and Given a Quick Jerk.

Two Scrub Brushes Fastened to a Mop Stick Make a Quick and Ideal Way of Cleaning Springs Without Getting Under the Car.

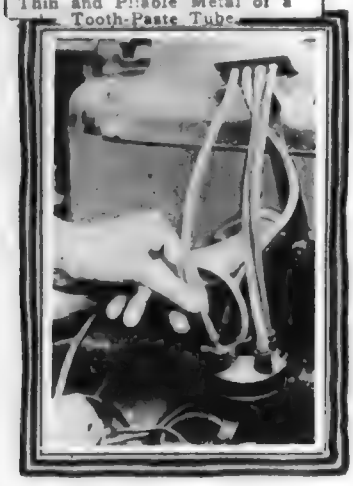
One Way of Quickly Mending Loose Cap on a Country Road,—by Inserting a Small Piece of Match-Stick in the Center, Preventing Further "Skidding."

A Flashlight Attached to a Screw Driver by Means of Adhesive Tape, Throws the Light Just Where the Work on the Motor Is Being Done.

Stalled on a Country Road on Account of a Dying Battery! Don't Give Up! Stop a Passing Car. If You Have With You Two Wires, Connect the Positive Wires of the Passing Car's Battery to Your Own, Also the "Negatives." This Aid Will Enable the Car to Start and Will Give the Dying Battery a "Transfusion."

When "Near Mechanics" Try to Adjust Your Carburetor, It Is Often Hard to Get It Back Again Into Proper Adjustment. One Way of Preventing This Meddlesome Practise Is to Cover the Adjusting Screws of the Carburetor With Sealing Wax.

When the Distributor Holes Become Worn an Excellent Tightener May Be Made by Wedging Into the Holes the Thin and Pliable Metal of a Tooth-Paste Tube.



A Toy Periscope, to Which Is Attached a Small Flash-Light, Will Quickly Locate Lost Bolts and Nuts Which Have Dropt Into the Cavernous Drip Pan. Such an Electric Periscope Is Useful in Numerous Other Ways.

Take a Nail File on Your Auto Tour. It Is Available for Polishing Off the Corroded Contact Points of the Distributor When It Fails to Carry the "Juice" to the Plugs. It Is Better Practise However to Purchase a Thin Knife File Especially Made for Such Purposes. Procurable at Tool Supply and Auto Shops.

Digitized by Google
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

"In 1999"

"Scientific Progress in the Last Century. Presidential Address Before the American Academy of Science, September, 1999."

By FRANKLIN RUTH

Gentlemen of the Academy:

AT the close of this twentieth century we look back upon a more brilliant array of scientific achievements than man has ever been privileged to see, or imagine. within the last few decades our earth has entered upon an era that surpasses the greatest expectations of the nineteenth century philosophers. Civilization has advanced at a rate comparable to a geometric progression, and today we are living in the Golden Age of Science. In looking back upon this century, we should review some of the most significant achievements of the past, and note their bearing upon progress and their relevance to the science of today.

The dawn of modern science occurred in 1898, when the discovery of radium and its radioactive properties was made by the Curie's. The importance of this discovery can never be too greatly emphasized, for it marks the actual conception and birth of the principles upon which today's science is founded. The untiring investigations of those great pioneers of modern science, Rutherford and Soddy, in the field of radioactivity, soon caused them to announce the hypotheses of atomic disintegration and evolution of the elements. Altho these theories were at first discredited and regarded in the same light as Perpetual Motion, the undeniable existence of enormous reservoirs of energy in the minute atom, as evidenced by radium, soon attracted the attention not only of scientific circles, but of the whole world. Discovery followed discovery. Research became busy with the momentous question whether artificial means could accelerate or retard the processes of spontaneous disintegration. Civilized nations became excited and expectant. Vivid fiction, exploiting the imaginary results of the discovery of atomic disintegration, was widely read, and increased the credulity of the people.

It was at about this period that the Great War occurred. Altho this world disaster took a great toll of life, it proved to be an impetus to scientific advancement. At the close of the War the United States found itself the creditor of almost the entire European continent, whose nations were on the verge of bankruptcy and revolution. Unrest was widespread. Crises between labor and capital were imminent. Numerous strikes occurred, and Bolshevik uprisings in Russia threatened to undermine all governmental control and order. The air seemed charged with something that stifled all thoughts of resuming prewar existence. Over all hung unconscious, vague dread, grasped in its entirety by only a few minds of scientific preeminence. Prophets and religious fanatics preached the end of the world and the arrival of the Millennium. The world was ripe for some cataclysm that would overwhelm civilization and possibly sweep all life from the planet.

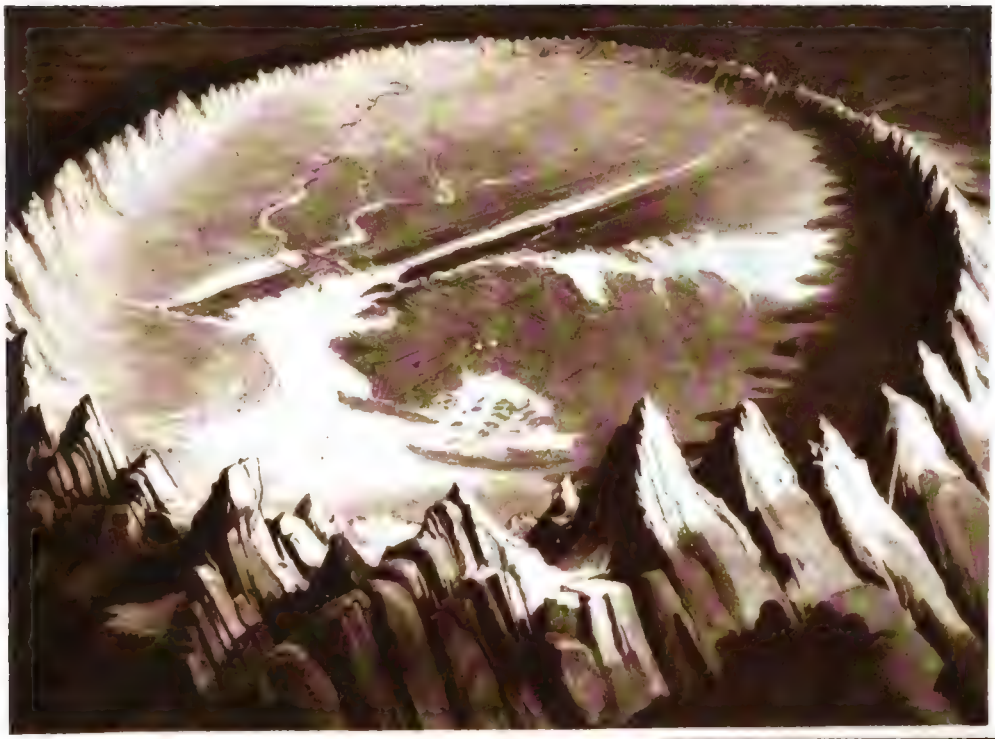
Suddenly, in 1924, occurred the first phenomenon of a series, which created physical disturbances sufficiently powerful to attract general attention. Scientific investigators, however, with the aid of their delicate instruments, had detected weaker but similar disturbances at previous periodic intervals. The world waited anxiously for words that might come from scientific men, identifying the cause of the mysterious phenomena. Scientists knew that the

(*Continued on page* 1361)

"......Thirty-Foot Tubes Were Excavated Thru the Earth's Diameter, Reaching From a Large Industrial Center on One Side to Some Extensive Agricultural Area Upon the Other. Africa, China, Australia and Parts of South America Were Touched. As These Tubes Were Sunk, They Were Lined With Browning's Electro-Heat Converting Apparatus, Which Turned the Intense Heat of the Bowels of the Earth Into An Immense Voltage, Giving An Electric Current, But Left the Interiors of the Tubes Relatively Cool and Insulated From the Fiery Medium Thru Which They Past. Food and Other Commodities Were Then Quickly Hauled Over Extensive Railroad Systems to the Mouths of the Tubes and the Elevator-Like Carriers Were Dropt Thru the Center of the Earth. The Momentum Gained in the 4000-Mile Drop Carried the Cars Past the Center of the Earth and Up to Within a Few Feet of the Opposite Surface. At This Point They Were Caught by Automatic Catches and Giant Electric Hoists Hauled Them to the Surface....."

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



One of the Giant Craters on the Moon's Surface Can Easily Contain the Whole of Greater New York City, as the Illustration Above Shows.

Trip to the Moon

WE know perhaps more of the configuration and physical make-up of the moon's surface than of any other heavenly body, due to our industrious and untiring astronomers. There are few regions of the moon's side facing the earth that have not been carefully explored and charted. Altho the moon is over 238,000 miles distant, our large telescopes bring the lunar landscape sufficiently into range so that all of the larger mountains with their ranges and craters are readily explored. The two illustrations on this page represent lunar scenes as we would see them, if we actually were to visit the moon.

In the first place, the moon, having no atmosphere, the sky as it would be seen from our satellite, is inky black with the stars shining forth in a brilliancy never viewed from the earth. A brilliant sun shines out of a black sky, while the sun itself is surrounded by a wonderful corona with its magnificent streamers only partly seen on earth at the time of an eclipse. Some of the lunar mountain ranges are tremendous, and we have nothing like them on earth. The craters of some of these huge extinct volcanos are of tremendous size; some of them measured across the bottom are more than 150 miles in extent, and you could readily place the state of Rhode Island in one of these huge depressions.

Our top illustration shows only a moderately large size crater, and it will be seen that New York City and environs would readily fit into such a baby crater, having a diameter of some 50 miles. As for height the lunar mountains are truly titanic. Some of these mountains are over 28,000 feet in height. Standing at the foot of one of these giants they seem to topple over on one due to the perspective, the same as when you stand at the foot of a skyscraper and look upwards. It seems to be bending over on you. When the sun shines on these huge mountains, it is of course possible to see all the way up as there is no atmosphere and no clouds to impair the vision. Such a sight must be overpowering and grandiose.

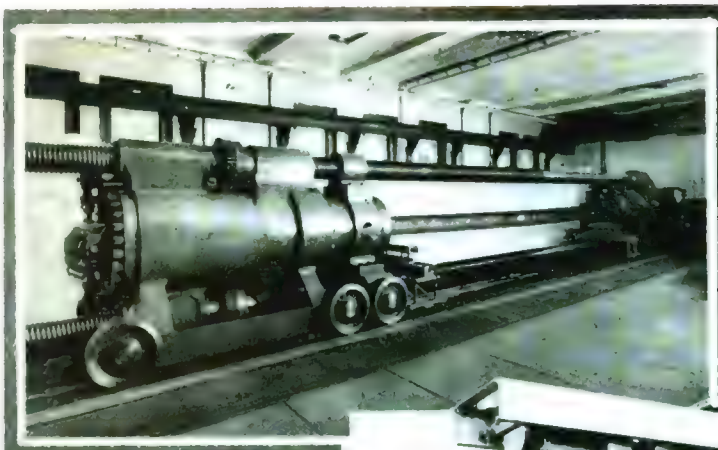
At the foot of these mountains we see huge cracks running in all directions, and these cracks are vast canyons in themselves, much deeper than we know of on earth. They extend for miles down into the bowels of the moon, and a fall into one of them would, of course, mean instant death to the traveler.

But the most impressive and terrorizing experience to the future moon traveler will undoubtedly be the vast death which is on evidence at every hand. The moon is a dead world as we all know, and there are no animals and there is probably no vegetation; only barren rocks greet the eye. Everywhere is silence; everything is dead and lifeless, and the future traveler must be encased in a sort of diver's costume with a glass-windowed helmet as he must bring with him his own air if he wishes to stay alive. And, he does not wish to stay long on the moon unless he walks around the foot of the mountains because there are possibly few places as unsafe as the moon itself. Huge meteors are crashing down almost continuously, and there is no atmosphere as on earth to act as a buffer. These

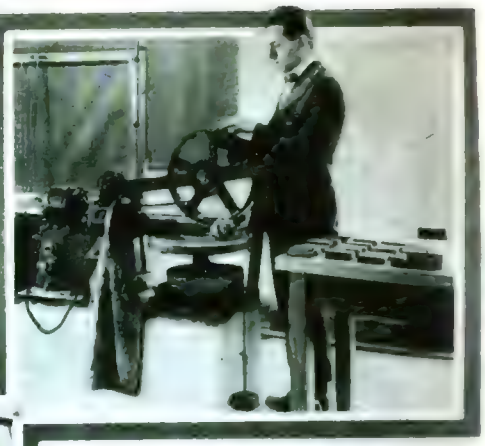
(*Continued on page* 1355)

Close-up View of the Mountains of the Moon Showing Their Precipitous Sides. The Moon Has No Atmosphere and So Even If an Adventurous Earthly Being Should Make the Trip Some Day, to Our Neighbor the Moon, He Would Not Find It a Very Salubrious or Pleasant Place on Which to Take up His Habitation, for the Only Way He Could Live on the Surface of the Moon Would Be by Providing Himself With an Outfit Similar to that of a Diver's Suit, Equipt With an Oxygen Tank and Artificial Air Device.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



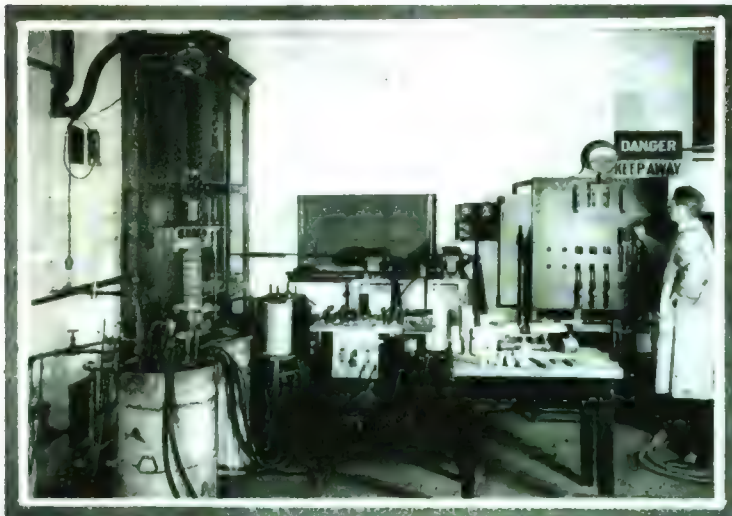
hoto at Right Shows But One of the Thousands of Activities Carried on in the Bureau of Standards Laboratories. That of Testing the Wearing Quality of Sole Leather. Pieces of Leather Are Placed on a Wheel Which Turns Against an Emery Disc, Carrying the Weight of a Man.



This Giant Testing Machine at the Bureau of Standards Laboratory, Washington, D. C., Can Register With Equal Accuracy, the Power Required to Crush an Egg Shell or That Required to Crumple Up the Strongest Steel Girder. Its pulling Strength Is 1,150,000 Pounds and the Maximum Crushing Power Is 2,300,000 Pounds.

Railroad "Track Scale" Testing Car. Built By the Bureau of Standards Experts. Each Weight Has a Value of 10,000 Pounds or 5 Tons, and the Car Is Sent About the Country to Test Railroad Track Scales, and Also to Serve as a Standard By Which the Scale Testing Cars of the Various Railroad Companies Are Calibrated.

The Preparation of Pure Iron Alloys Is Carried on in the Special Laboratory Shown Below, Where Electrolytic Iron 99.97 Per Cent Pure Has Been Obtained. Two Vacuum Electric Furnaces With the Necessary Transformers and Control Switchboards Are Here Shown.



The Photograph Above Shows the Long Tank of Water Used in Calibrating Water Meters. A Miniature Control Car Runs Along the Rails at Either Side of the Tank While the Operating Mechanism of the Water Meter Being Tested Is Carried Thru the Water at Any Desired Speed and the Reading Checked With a Standard Meter Carried on the Car. The Speed of the Car Is Controlled by a Rheostat.

The Photo at the Left Shows One of the Hundred of Different Technical Departments of the Bureau of Standards Laboratories. Here We See One of the Bureau's Engineers Making Researches Into the Heat Liberated by Different Types and Makes of Electric Light Bulbs.

At a Temperature of 573 Degrees Crystalline Quartz Changes Into Another Crystal With a Transfer of Energy During the Process. Remarkable Results Regarding the Temperature Changes Occurring in Crystalline Quartz Have Been Carried Out by Means of the Extremely Powerful Electro-Magnet and Auxiliary Apparatus Shown in the Photo Above.

Digitized by Google

Original from
UNIVERSITY OF ILLINOIS AT
URBANA-CHAMPAIGN

Recent Work of the Bureau of Standards

ALTHO you and I, as citizens of a great and progressive nation, perhaps do not realize the fact, yet every time we purchase a pound of butter or a sirloin steak at the grocers or butchers, these food products are weighed out on a scale, which has been checked with the standards provided by the National Bureau of Standards Laboratories located at Washington, D. C.

One of the accompanying photographs shows a most interesting sight,—that of a railroad track scale testing car built and calibrated by the Bureau of Standards scientists. This car is fitted with weights of 10,000 pounds or 5 tons each; it is sent about the country to test the railroad track scales and it also serves to set the standard by which the test cars of the various railroad companies are evaluated.

Altho we are prone to think that the average weighing scale is accurate in the majority of cases, it has sometimes been found that as high as 50 per cent. of the larger scales inspected have been quite incorrect,—due simply to the fact that no proper facilities had been available heretofore for testing the scales.

Another photograph shows one of the thousands of activities carried on at the laboratories of the Bureau of Standards, —that of testing the wearing quality of sole leather. In the machine here illustrated, pieces of leather are placed on a wheel which turns on an emery disc carrying the weight of an average man. After carrying on this test for a definite period of time, a careful record of which is kept of course by the engineer in charge of the work, the exact wearing quality of the leather by this simple test can be determined with exactitude.

TESTING WATER METERS WITH MINIATURE ELECTRIC TROLLEY CAR AND TANK.

One of the accompanying photographs shows the long tank of water used in making accurate standardization tests on water meters,—not the ordinary variety used for integrating the number of cubic feet or gallons of water passing thru your kitchen and bathroom spigots,—but for accurately testing the large motors employed to determine the force and quantity of water used to operate mills and factories. In this case, instead of having the water flow thru a pipe or channel and also thru the meter in order to make the necessary test on it, the water simply remains stationary in the tank shown, while the meter under test is secured on an arm projecting down into the water, which arm is securely fastened to the small electrically controlled car, shown. Many of us probably envy the man who makes these tests, for most of us in our maturity, still manifest, secretly, a great deal of the juvenile love of the trolley motorman's job.

By means of the electric controller box on the trolley car, the meter can be moved at any definite speed desired, thru the still water and the readings of the meter being tested are accurately checked with those indicated by the standard meter. The standard meter used for checking such measurements in any case, is of course calibrated previously by some other means than the one usually employed in checking up the meters sent in by patrons of the Bureau. In the case of water meters, this is often done by weighing and measuring the amount of water passing thru the meter in a given time.

Another one of this interesting Bureau's tests is illustrated in the photo showing one of the engineers making researches into the heat liberated by different types and makes of electric light bulbs. Contrary to popular opinion, the services of the Bureau of Standards are intended not only for governmental work, but it is maintained and stands ready to make any test, within its functions, for private citizens, companies or corporations, at a reasonable charge.

It is a mark of distinction and of the highest order for any new invention or device, to have bona fide tests made in the Bureau of Standards' laboratories.

A Few "May" Articles

Salvaging Ships in 24 Hours with the Del Ido Salvaging Apparatus.

How the Size of Betelgeuse Was Measured by the Interference of Light Waves—By Prof. T. O'Conor Sloane, Ph.D. LL.D. Popularly explained with diagrams and photos of the actual apparatus.

What a Drop of Water Looks Like —With startling microphotographs showing some of the strange organisms existing in an ordinary drop of water.

What Causes Insects to Fly Towards a Light? With photographs. An exceptionally interesting article giving the latest discoveries of science concerning this phenomenon. By Dr. E. Bade.

How Radium is Used to Cure Cancer. Clearly illustrated with exceptional pictures. By Joseph H. Kraus.

Colloidal Fuel—How the Very Essence of Coal can be Extracted and Piped for Hundred of Miles. Interestingly explained in picture and story.

Dr. Pringle discusses Ether, the Sun and the Earth. A brilliant yet popularly written scientific discourse which everyone can enjoy. Related by our learned friend—John De Quer.

Chinese Pigeon Whistles—With Actual photos.

Instruments that Measure the Stars —Illustrated.

Optical Lenses Colored by Electricity. By Harry Rosenthal, Cons. Engineer.

Simple Substitute for the Photostat—Explaining how to copy pictures and text from books, magazines, etc., directly without a camera or other apparatus. By D. P. W. Maunsell.

Monsters of Long Ago—Wonderfully Illustrated. By Dr. E. Bade.

GIANT TESTING MACHINE MEASURES POWER TO CRUSH AN EGG.

One of the accompanying photos shows a giant testing machine operating with screw-shafts, and which machine can register with equal accuracy, the power necessary to crush an egg shell, or that required to break down the strongest steel sky-scraper girder. The machine here illustrated is suitable for testing any piece of steel, iron or other metal from a few inches in length up to 30 feet. It can exert a pulling strength up to 1,150,000 pounds and a crushing power of 2,300,000 pounds. The great screw-shafts are 40 feet long and one foot in diameter. Instead of water being used in the cylinders to furnish the necessary hydraulic power, oil is utilized.

Several of these machines are in use by the Bureau of Standards, for testing steel beams and other structural members. In the Pittsburgh branch of the Bureau of Standards' Laboratories, one of the most powerful testing machines, if not the most powerful in the world, has been installed; this is the great 10,000,000 pound Olsen testing machine. These machines are used in a series of investigations jointly conducted by the Bureau of Standards and the American Society of Civil Engineers for the purpose of quickly calibrating and checking the formulae for computing the strength of steel columns, beams and other members upon which formulas the efficiency and safety of our present day offices and industrial buildings depend.

The huge Olsen testing machine stands four stories high and somewhat resembles the horizontal type of testing machine shown in the accompanying photo if the latter were changed to the vertical position. It is often used for determining the crushing or compressive strength of such materials as a section of a brick or concrete wall, etc. It is capable of exerting a pressure as high as 10,000,000 pounds or 5,000 tons,—sufficient to break the steel propeller shaft of the greatest war vessel afloat.

A specimen brick pier made up for test to ascertain the qualities of a particular brick, measured 16 feet high by 48 inches square. Some idea of the tremendous crushing power of this machine can be gained by imagining what force must be exerted to cause this solid brick column 4 feet square and 16 feet high to crumble.

SPECIAL EQUIPMENT FOR PREPARING PURE IRON ALLOYS.

The preparation of pure iron alloys calls for special laboratory equipment, which demand has been met by the National Bureau of Standards, where electrolytic iron 99.97 per cent. pure is obtained. The illustration shows the apparatus in use, consisting of two electrical vacuum furnaces, together with transformers and switch boards for the electrical control. On the table, included in the photograph, are special crucibles, finished ingots, together with rolled bars from these ingots, and tensile test specimens.

By way of insuring a reliable foundation for the scientific study of the effects of the small portions of impurities always present in iron and steel it is essential to have accurate knowledge of the properties of really pure iron and alloys of pure iron with known amounts of single impurities, intentionally added. Such iron, in the absence of impurities, is being obtained by the Bureau of Standards. It is melted in a vacuum to

(*Continued on page* 1326.)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Home Electrics

By G. L. HOADLEY, M. E.

When the Fuse Burns Out

IT usually happens that the fuse blows, putting the lights out at the worst possible time; for instance, when the housewife is nicely started on the big family wash with the electric washer, putting it out of commission Exasperating, isn't it? The head of the house is away at work too, else he could worry about it. The Electric Power Co., will send a troubleman out to make repairs—and charge you for his time and three or four fuses, when only one was needed. You will need to wait anywhere from one to two hours for him to arrive and that will delay your washing so you can't get started again till after lunch. If you only knew how to locate the blown fuse and put in a new one, you could get the washer going again in five minutes and have the wash finished by 12 o'clock. Why not learn how? The thing is very simple and if directions are followed, you can't possibly receive a shock.

First, let us consider the purpose of the fuse. Why must fuses be put in the circuit? They are a nuisance when the fuse blows we all agree, but suppose your washer had not been protected by fuses. You get something caught in the ringer that stalls the motor. It is not built to withstand so heavy an overload—for more than a few seconds before it burns out. A new motor costs $25 or $30. Repairing the motor may cost $15 or $20. A new fuse costs 8 to 10 cents. For the protection of your motor then, you need fuses from the standpoint of cost. Fire risk is much greater also without fuse protection. Any person foolishly using pennies, a nail or wire, etc., to replace blown fuses courts fire disaster, besides trouble with the Power Company if their transformer or expensive apparatus is burnt out as a result.

Fig. 1 shows the ordinary 6 to 10 ampere plug fuse used on lighting circuits. It consists of an alloy of lead and zinc principally, in the form of a wire or ribbon. In all cases it is enclosed completely in order that the heated metal will not be thrown onto material that will easily catch fire when the fuse blows.

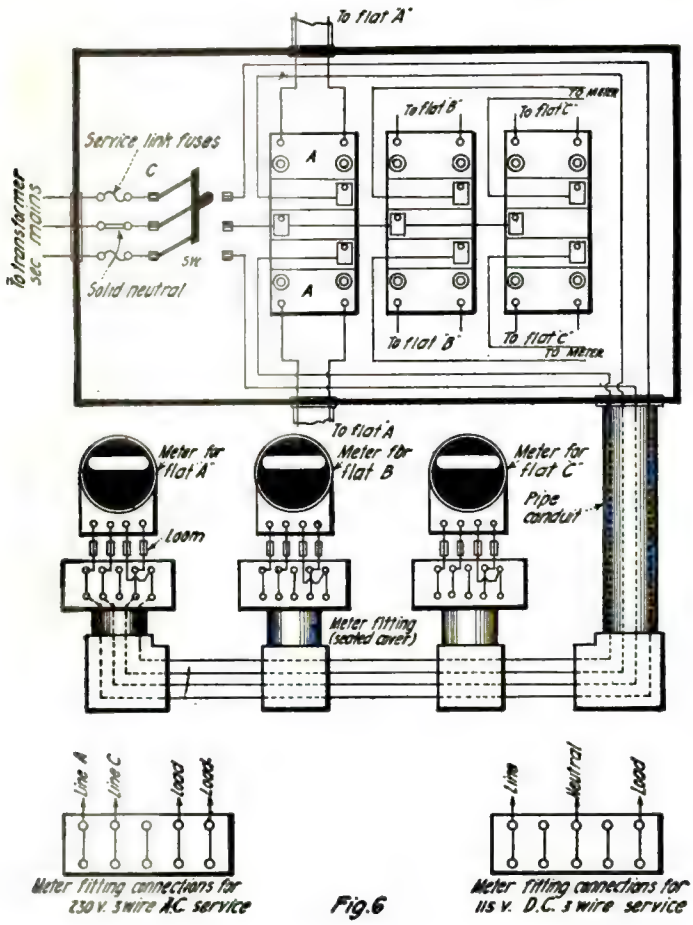


Fig. 6

How the Fuse Blocks and Electric Light Meters Are Often Arranged In an Apartment House In the Large Cities, Where Two to Three Circuits for Each Family Are Brought Down to the Cabinet Box. In Trying to Locate a Blown Fuse In Such an Installation It Is First Necessary to Determine Which Fuses Control the Circuit Leading to Your Apartment, or Else You Will Have to Test Out Each Circuit in the Cabinet, Either by Examining the Fuses or by Testing with a lamp. Once You Have Located a Blown Fuse It Is the Safest Plan to Open the Main Switch When Replacing the Fuse or Fuses.

Do not replace that 6-ampere fuse with a 20-ampere fuse for house lighting circuits, because that means NO FUSE protection for any motors, lamps or other things on the circuit which take less than 20 amperes, and you will run the risk of burning out your motors, etc. Furthermore, No. 14 B. & S. gage wire, which is ordinarily used for wiring houses, will only carry safely 15 amperes; if a heavier current is carried continuously, the wire overheats and the insulation is gradually destroyed causing trouble later or else fire results.

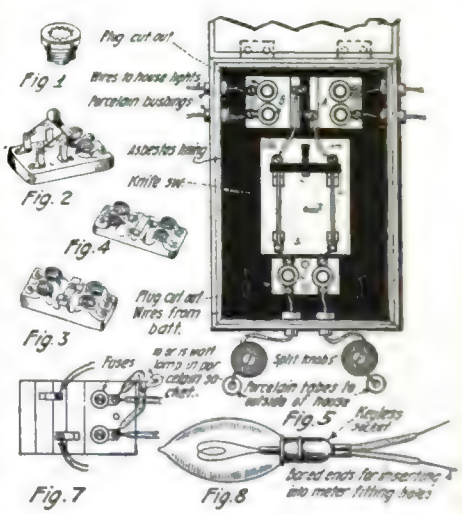
When a fuse blows it is generally caused by too big a load. It might, of course, be a *short-circuit* or *ground;* but in the majority of cases it is due to either a sudden heavy overload or else a steady heavier load than the fuses are intended to carry. This causes them to gradually heat up and melt. Getting something stuck in the ringer is an example of a sudden heavy overload; while operating the washer, the vacuum sweeper, the coffee percolator, and the toaster or some similar combination ALL at one time off of one circuit, is an example of a steady overload that will melt an ordinary 6-ampere fuse shortly.

Generally, an ordinary house will have at least two branch circuits and quite often more. Sixteen lights is all that is supposed to be put on one branch circuit. Fig. 2 shows an ordinary single branch fuse cut-out block with switch suitable for one two-wire circuit. Fig. 3 shows a double-branch fuse cut-out block used for two two-wire circuits. Fig 4 shows a fuse cut-out block for two two-wire circuits with 3-wire service. Fig. 5 illustrates a typical two-wire installation with a double branch fuse cut-out block for two separate house circuits.

The cabinet-box is usually located in the basement and has a switch inside as shown. After opening the self-closing hinged door of the cabinet-box, pull this switch open the first thing, then replace both fuses of one circuit at A, with new fuses, and close the switch. If this does not remedy the trouble, OPEN the switch and replace fuses in B with new ones. Then close the switch. If the trouble was merely an overload, following these simple directions will restore service as a rule. Once in a hundred times the service fuses C are blown. You can easily observe whether or not this is the case. There is absolutely no danger of your receiving a shock if you OPEN the switch before replacing the fuse. Do not attempt to replace the service fuses C, if they are blown, unless either you or the man of the house knows considerable about electricity, as those contacts are alive and dangerous. Better call up the power company and have them replace them.

In large cities, the procedure for flat buildings where two or three circuits for each family are brought down to the cabinet-box, shown in Fig. 6, is slightly different. It now becomes necessary to either first determine which cut-outs control the circuits leading to your own particular flat or else test out each circuit in the cabinet-box. The first way is safer to follow for one unfamiliar with electricity. Adopting this plan then make it the first duty

(*Continued on page* 1346)



Several Styles of Fuse Blocks Are Shown In the Illustration Above, as Well as a Typical Testing Socket and Lamp.

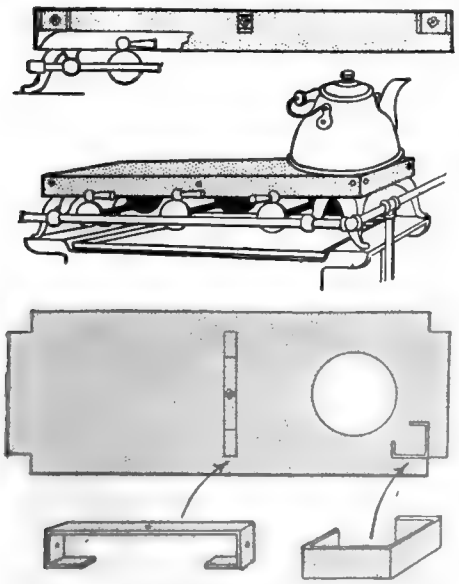
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

HOME-MADE GAS SAVER.

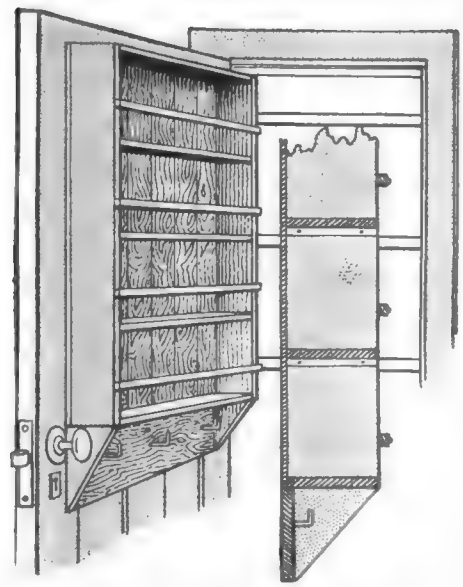
A HOME-MADE gas saver that has the value of saving that household necessity is shown in an accompanying illustration. It consists of a sheet iron, box-like cover that is made by the home mechanic to fit



This Home-Made Gas Conserver Is Constructed from a Piece of Sheet Iron Cut and Bent to the Shape Shown, or to Fit the Particular Stove at Hand. The Heat Ordinarily Wasted by the Gas Flames Shooting Up All Around the Tea Kettle or Other Vessel, for Example, Are Caused to Heat the Sheet Iron Top in the Manner Apparent—a Real Economical Idea!

closely over the top of any sized gas stove or range. It has but one hole thru which the heat from a single lighted burner may come in direct contact with any cooking utensil. The sides of the cover are held by strap iron pieces, bent into the shapes shown (3/16" x 1" iron), and 3/16" bolts. These retaining pieces also serve as supports for the cover, and its load of utensils when in use, by resting as shown on the top of the stove. The cover can be attached or removed as quickly and as easily as placing a kettle on the stove.

The idea is that with one burner lighted, and a kettle over the hole above that burner, heat is confined and distributed over the area of the cover to such a degree that other utensils are heated and food cooked without any of the other burners being used, and with no loss of heat applied to the kettle over the lighted burner. In this way one burner does the work of the entire group of burners.



Housewives Are Always Wishing for More Shelves on Which to Place Their Dishes and Cooking Utensils, Especially in and About the Kitchen (Which Is Not Always So Large Nowadays). This Idea Provides Extra Shelf Room Right on the Inside of the Closet Door, Suitable for Dishes and Utensils.

CABINET FOR KITCHEN DISH-CLOSET.

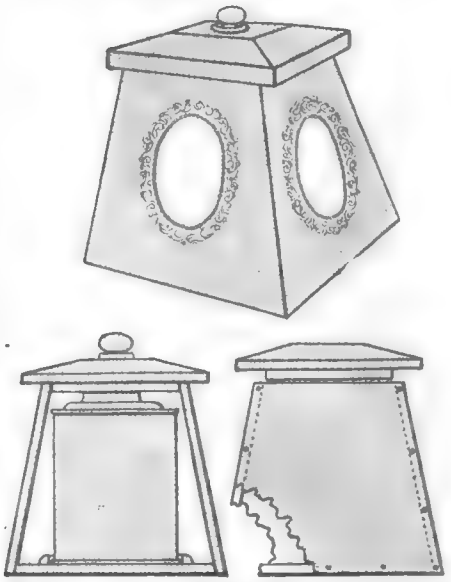
There is usually about nine inches of waste space between the inside of a closet door and the front edge of its shelves which can be used to good advantage, in these days of housing shortage. The suggestion is for the dish closet in the kitchen, and consists of a four-shelved cabinet, with its supporting brackets made useful by a connecting board with hooks for hanging up pots or frying-pans. This idea we imagine will meet with wide approval, for it has advantages which are apparent to every orderly house wife, yet for some reason such an arrangement has never been utilized. As the cabinet is swung more or less quickly on the moving door it should be secured firmly thereto with screws or nails.

LEATHER TOBACCO BOX.

Herewith is shown a leather covered and metal trimmed tobacco box that the home mechanic can make during his spare moments. The design is of that flexible kind provided to fit any special brand of tobacco can which the maker is in the habit of using, and consists of a wooden frame, with wooden cover, upon which the leather or leatherette is glued. No attempt is made to bevel the corners of the box, this part being nailed together as shown. The top consists of two pieces of wood, joined to form a lip and lid, and a brass knob—screwed on when the leather is in place. Brass oval frames, for the portraits of favorite lady friends, are also nailed over the leather in the places illustrated on the sides of the box. Frames of this sort are commonly sold for similar uses. To prevent the tobacco can from shifting about in the box a moulding is tacked to the box bottom to fit the can and hold it in place before putting in that part.

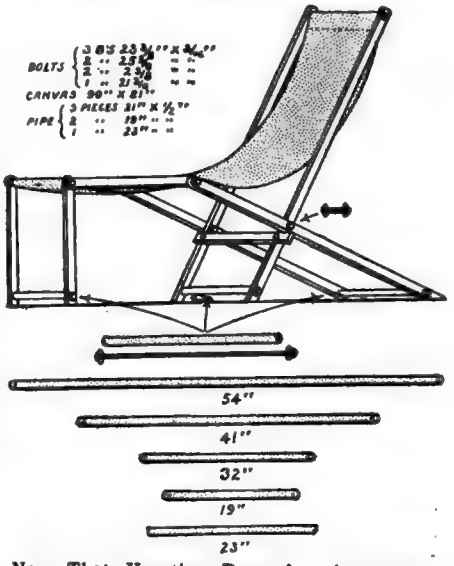
HOME-MADE STEAMER CHAIR.

One of the most comfortable lounging chairs for out-of-door use is the old home-made folding chair with foot rest, constructed somewhat along the lines of the steamer-chair. The canvas seat and rest being in one piece, and suspended at its ends, just fits somehow and makes the chair cool and "comfy." The cut herewith shows a method of constructing a chair of this sort. The lumber is 1¾" x 1" hardwood, say ash or oak, and should be straight-grained and extra tough. As small bolts as possible (¼") should be used so as not to make the holes in the wood so large as to weaken it. Iron gas pipe, fitting the ¼" bolts, is used to keep the wood pieces spaced apart and in place as shown. A stop for holding the back in position is also made of wood and screwed in the place illustrated. Heavy canvas, such as is used for tents, is provided in the rough 21" x 90", when a 1" hem is then formed on each side making the piece 19" wide. This is looped, and fastened by stitching, so that when placed over the pipe when the chair is put together the seat will hang about as shown in drawing. The bolts may be slightly riveted, once the chair is put together, to prevent nuts from working loose. Dimensions of bolts, pipe and lumber are given in the illustration.



There Is Nothing That Is More Available for the Requirements of the Man in the Household Than an Attractive Container for His Tobacco Can or Humidor, and the Author Here Describes and Illustrates a Design for Such a Container Which Should Be Finished in Leather or Burnt Wood.

When complete, this steamer chair can be placed on the porch or in the shady back yard. As no chair in the house can compare with it when it comes to comfort, this steamer chair may be desired for parlor use; and to remove any trace of its "home-made" appearance, besides adding greatly to its attractiveness, it would be advisable to have it covered with flowered cretonne or other material, so as to match the summer coverings of the other furniture.



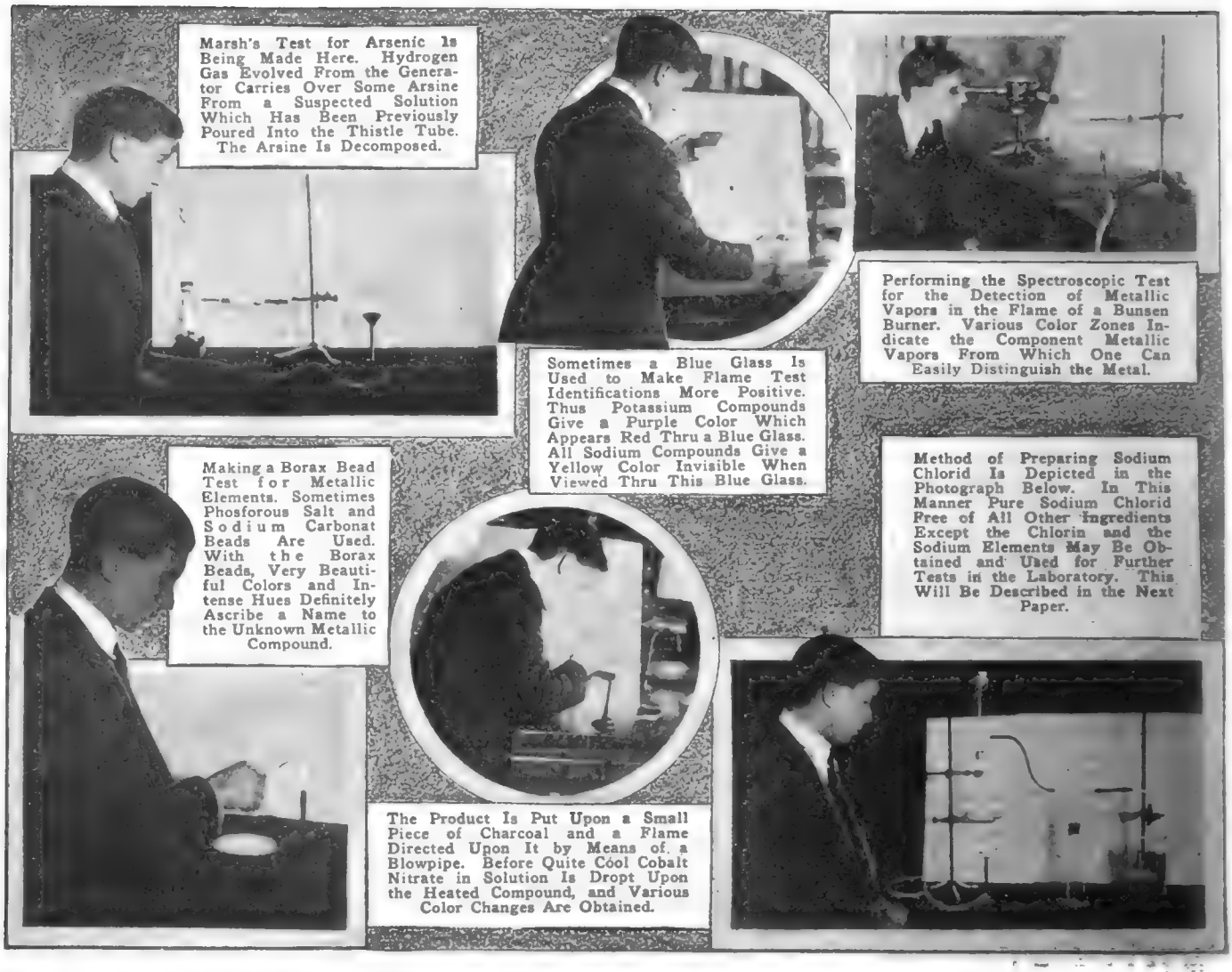
Now That Vacation Days Are Approaching, This Home-Made Steamer Chair, Which Is Simplicity in Itself, Will Appeal to Many. Contrary to General Opinion, This Type of Chair Is Much More Comfortable Than Might Be Supposed. The Canvas Forms Itself to the Contour of the Body Nicely.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

SOME SIMPLE CHEMICAL TESTS



Marsh's Test for Arsenic Is Being Made Here. Hydrogen Gas Evolved From the Generator Carries Over Some Arsine From a Suspected Solution Which Has Been Previously Poured Into the Thistle Tube. The Arsine Is Decomposed.

Sometimes a Blue Glass Is Used to Make Flame Test Identifications More Positive. Thus Potassium Compounds Give a Purple Color Which Appears Red Thru a Blue Glass. All Sodium Compounds Give a Yellow Color Invisible When Viewed Thru This Blue Glass.

Performing the Spectroscopic Test for the Detection of Metallic Vapors in the Flame of a Bunsen Burner. Various Color Zones Indicate the Component Metallic Vapors From Which One Can Easily Distinguish the Metal.

Making a Borax Bead Test for Metallic Elements. Sometimes Phosforous Salt and Sodium Carbonat Beads Are Used. With the Borax Beads, Very Beautiful Colors and Intense Hues Definitely Ascribe a Name to the Unknown Metallic Compound.

Method of Preparing Sodium Chlorid Is Depicted in the Photograph Below. In This Manner Pure Sodium Chlorid Free of All Other Ingredients Except the Chlorin and the Sodium Elements May Be Obtained and Used for Further Tests in the Laboratory. This Will Be Described in the Next Paper.

The Product Is Put Upon a Small Piece of Charcoal and a Flame Directed Upon It by Means of a Blowpipe. Before Quite Cool Cobalt Nitrate in Solution Is Dropt Upon the Heated Compound, and Various Color Changes Are Obtained.

THERE is nothing that gives the Amateur Chemist more genuine satisfaction than to be able actually to make *tests for chemical substances.* The whole subject of Qualitative Analysis, one of the chief branches of the science of chemistry, consists in doing in a systematic way this very thing. A little later I propose to take up in this series of articles an elementary course in qualitative analysis, but in the present number I shall deal only with a number of isolated sets of chemical tests which are much used in particular cases.

Flame Tests: There are a number of the metals which give to the Bunsen flame characteristic colors. In order to do this some compound of the metallic element must be present in the flame in the form of incandescent vapor. The metal which gives the most striking and persistent color to the flame is sodium. It gives a brilliant yellow and only the faintest trace of the metal is necessary to color the flame. Indeed with the aid of the *spectroscope,* a very delicate instrument for the detection of elements in the form of incandescent vapor, so small a quantity as one-hundred-thousandth of a grain of sodium may be identified with perfect certainty.

For use in making flame tests a mounted platinum wire will be necessary. Of course platinum is very expensive but the cost of a 4-inch length of about No. 22 wire will not be prohibitive. To mount it fuse one end securely into the end of a short length of small glass tubing. Clean the wire by dipping it into a solution of concentrated hydrochloric acid and then heating to incandescence in the outer, or oxidizing flame, of the Bunsen burner. Never place it in the inner, or reducing flame, and always have a colorless flame, i.e., a non-luminous flame. If not you will injure the platinum.

Draw the clean platinum wire thru your fingers and then place it in the flame. Immediately you will notice the yellow color of sodium, for this element in the form of its compounds is everywhere present, even on your hands, and, as already stated, the minutest quantities will reveal themselves in the flame.

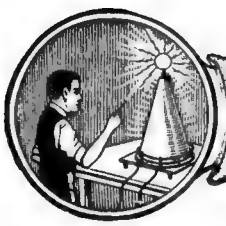
Now dip the wire into each of a number of solutions of sodium salts and in each case place the wire in the flame. In all of them the brilliant yellow of sodium will flash out and persist for several minutes. Before using with any other salt solution, the wire must be cleaned by dipping it into concentrated hydrochloric acid and reheating in the flame. Always repeat this operation until there is no color left. Figure 1 shows the proper position for the wire in the flame.

Hold a short piece of glass tubing in the flame until it has softened. You will note that the flame becomes yellow, showing the presence of sodium, for sodium is always present in glass.

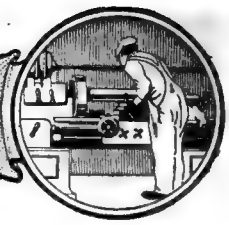
Obtain three small squares of cobalt-blue glass and, having dipt the platinum wire in the solution of some sodium salt, hold the three thicknesses of glass between your eye and the sodium flame. You will observe, however, that the yellow sodium flame is entirely cut off, because blue glass will not permit the passage of yellow light. This fact as we shall see is of fundamental importance in the detection of the potassium flame.

(*Continued on page* 1349)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



THE CONSTRUCTOR



A Model Electric Railway De Luxe

By Earl Christmas

UP on the third floor of their home in St. Paul, Allan and James E. Trask, youthful engineers, have built a complete electric railroad, perhaps the only one of its kind in the entire country. Its miniature locomotive is modelled after the big electric locomotive used in pulling the Chicago, Milwaukee and St. Paul trains over the Rocky Mountain division; the miniature electric type embodies practically all the features of its big prototype. In fact, the builders of the model, with just the ordinary tools and a few pictures of the big locomotive, had to work out in miniature problems similar to those which the General Electric engineers had to master in constructing the big engine.

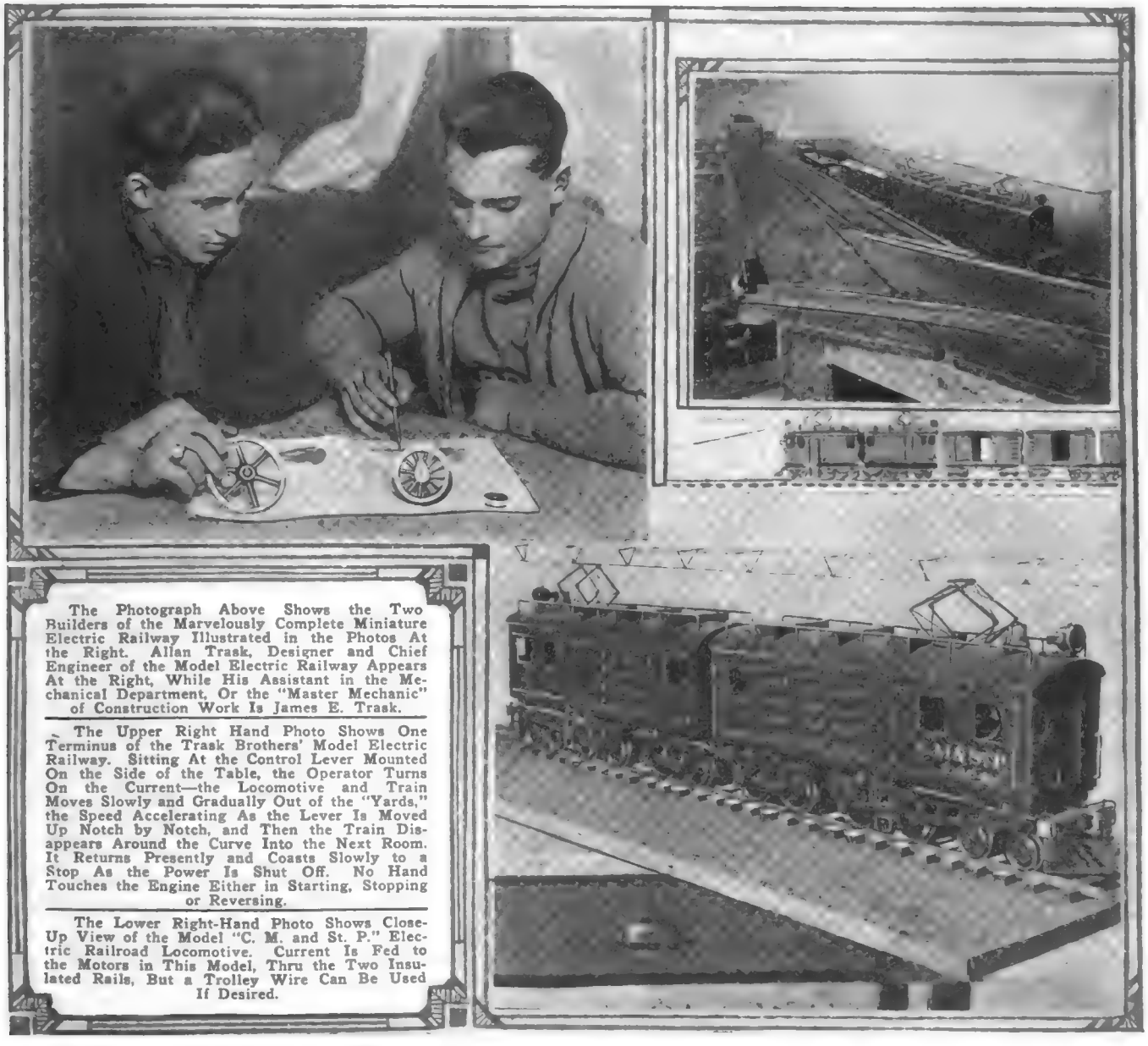
In addition, their problem was complicated to some extent by the very smallness of the model. For instance, a system of remote control had to be developed. A 300-watt generator set provides the power from the lighting current.

Sitting at the control levers, the operator turns on the current. The locomotive moves slowly and gradually out of the yards, the speed accelerating as the lever is moved up notch by notch, and the engine disappears around a curve into the next room, returning presently and coasting slowly to a stop as the power is shut off. Not a hand touches the engine in starting or stopping.

Twenty feet away, in another room, where it can't be seen by the operator, the train may be speeding along. The operator changes the levers, and back the train goes in the other direction, reversing its course electrically without the touch of a hand to the engine, so perfect has the system of control been developed.

Allan, now 22 years old, designed the miniature railroad and worked out the electrical problems. James, aged 17 years, did the necessary machine work, such as turning up the wheels and shaping the truck frames, in the shop at the local High School.

The engine is 38 inches long and weighs 48 pounds. It will exert a 10-pound pull at the draw-bar, which is sufficient to pull 250 pounds of smooth running cars on a level track. With a 100-pound train, it



The Photograph Above Shows the Two Builders of the Marvelously Complete Miniature Electric Railway Illustrated in the Photos At the Right. Allan Trask, Designer and Chief Engineer of the Model Electric Railway Appears At the Right, While His Assistant in the Mechanical Department, Or the "Master Mechanic" of Construction Work Is James E. Trask.

The Upper Right Hand Photo Shows One Terminus of the Trask Brothers' Model Electric Railway. Sitting At the Control Lever Mounted On the Side of the Table, the Operator Turns On the Current—the Locomotive and Train Moves Slowly and Gradually Out of the "Yards," the Speed Accelerating As the Lever Is Moved Up Notch by Notch, and Then the Train Disappears Around the Curve Into the Next Room. It Returns Presently and Coasts Slowly to a Stop As the Power Is Shut Off. No Hand Touches the Engine Either in Starting, Stopping or Reversing.

The Lower Right-Hand Photo Shows Close-Up View of the Model "C. M. and St. P." Electric Railroad Locomotive. Current Is Fed to the Motors in This Model, Thru the Two Insulated Rails, But a Trolley Wire Can Be Used If Desired.

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

will run full speed, which is proportionately 60 miles an hour.

The entire locomotive, except the motors and the gears, was built by the two boys from raw stock. The 16 driver and 8 pilot wheels were turned from solid brass castings. The wheels on one side of the locomotive have fibre bushings between the wheel and axle. As the current is carried by both rails of the track, the wheels have to be insulated one from the other.

The truck frames were cut from pieces of flat steel, drills being used to make the latticed part.

There are two motors, geared to eight drive wheels. The motors are wound for twelve volts. The drive wheels are worm driven thru a reduction of eighteen to one.

Since it would not be practical to use the current from storage batteries or to use alternating current, the builders have made a 300-watt motor generator set, composed of a one-fourth horse-power induction motor on the 110-volt lighting circuit and a small 12-volt D. C. automobile generator.

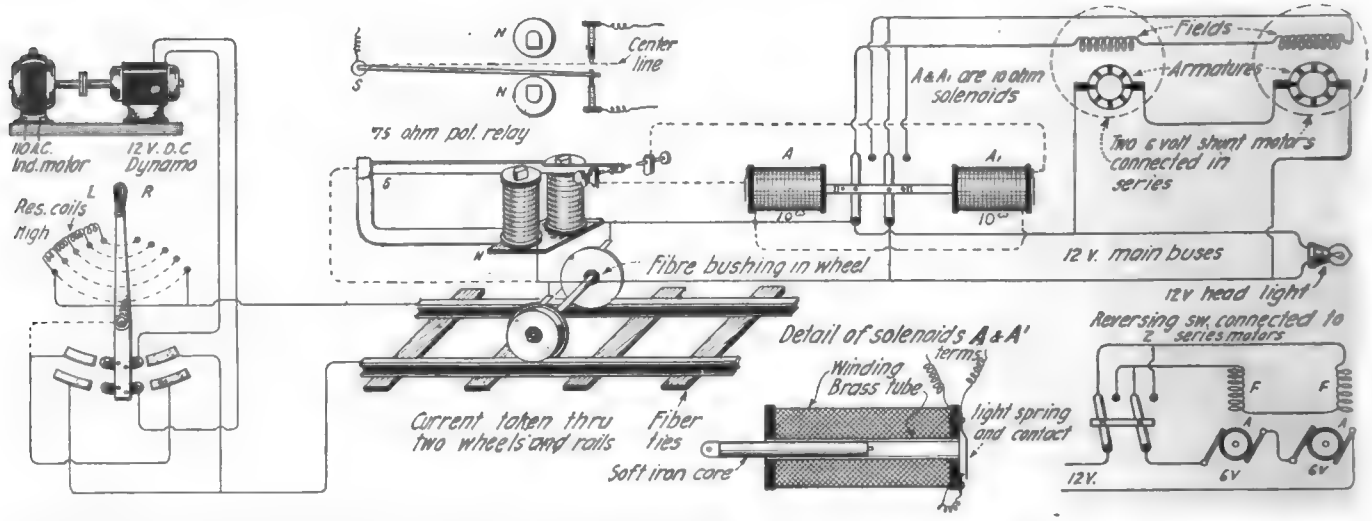
The two motors are connected in parallel to a relay reverser, which enables the locomotive to be reversed by changing the polarity of the current. This device is a combination of a permanent and an electro-magnet wound with fine wire, and shunted across the circuit in the engine. The movement of the electro-magnet mechanism on changing the polarity of the current throws a switch, which reverses the locomotive. (*A polarized relay is shown in the diagram appearing herewith.—Editor.*)

An unusual feature is a two-pound fly-wheel of solid brass mounted on the motor shaft just above the truck frame. By the use of the fly-wheel, the performance of the model is made strikingly similar to that of its monster prototype.

The body of the engine is made of heavy leaded iron such as used for automobile fenders. The bells were turned from a brass bar, and the cowcatchers were cast at a foundry from a pattern made by the youthful builders.

Railroad engineers who have called at the Trask home in St. Paul, to see the model have marveled at the correctness of the reproduction, and the ingenious manner in which the control has been adapted to the small locomotive. The C. M. and St. P. Railroad has started negotiations to borrow the miniature railroad for exhibition purposes, so much have the officials been imprest with it.

In addition to the locomotive, these two geniuses have built coal cars, box cars and a caboose, all faithful reproductions of the larger types. They have built a track some fifty feet in length, tunneling around thru the walls of three rooms and one closet, which happened to get in the way. Tunneling thru those walls almost aroused serious displeasure on the part of James E. Trask, Sr., but the desire of the builders prevailed, and with such success that Papa Trask was as much elated as the youths themselves.



One Method of Controlling Model Electric Trains Like That Shown On Page 1309, As Indicated in the Accompanying Diagram. The Necessary Direct Current for Operating the Motors Driving the Engine Can Be Taken Either From Storage Batteries, From a Step-Down Rheostat Connected to 110 Volt D.C. Circuit or Else From a Small D.C. Dynamo Direct-Connected to a 110 Volt A.C. Motor. A Combination Rheostat and Reversing Switch Is Suggested, Which Resembles Quite Faithfully the Large Controllers Used On Electric Locomotives and Trains. The Main "Trick" Embryo Electrical Engineers Would Be Interested in Probably, Is How the Locomotive Is Reversed While Running Along the Rails Without Having Recourse to Trip Switches Placed On the Track. One Way in Which to Reverse the Engine From the Single Control Switch and Rheostat, Is by Means of a Polarized Relay or Similar Mechanism. A Polarized Relay, Which May Be Constructed From a Polarized Bell Ringer Having a Permanent Magnet Field, Is Illustrated Above—Also Its Connections to Two Small Solenoid—Magnets Employed for Operating the "Current Reverse" Switch Connected to the Field Windings of the Two Motors. The Action of the Polarized Relay Is Based On the Fact That a Current Passing Thru It in One Direction Will Not Move the Armature Away From the Lower Contact, for Example; While a Current Passing Thru the Relay Magnets in the Opposite Direction Will Produce a Polarity Opposite to the Normal Field of the Relay, and Cause the Armature to Fly Over to the Upper Contact.

GARAGE TURN-TABLES AND BURGLAR ALARMS.

WE have under preparation an elaborate article for the Constructor Department in the May number which will appeal to all of our readers who own and operate an automobile, and that means almost everybody today. The automobile is hardly a luxury now,—it is considered a necessity and it is not by any means a cheap necessity for most of us, so that we are always on the *qui vive* as the French say, or on watch for new ideas which will help to protect our automobile from theft. The article on an electric turn-table for private garages also contains a lot of valuable information on various forms of burglar alarm circuits for garages, some of which operate on current obtainable from the lighting circuit, while others operate by means of closed and in some cases open-circuit batteries. Do not miss this valuable article in the next issue. Complete details for building and installing these various devices are given in detail.

HOW THE ELECTRIC LOCOMOTIVE IS REVERSED AND CONTROLLED.

The diagram appended herewith shows how the direct current supplied by the twelve volt potential motor generator set is reversed as well as varied in strength as it is applied to the two insulated rails of the track system. These rails may be made of brass, iron or copper strip about 1/16" thick, ⅜" to ½" in width, fitted into slots cut by means of a hack-saw into fibre or wooden ties. The speed regulator or rheostat can be arranged as shown, so that when the handle is in the center or zero position, no current is supplied to the rails. When the handle is moved to right and left, current is fed to the rails thru ment mounted on an insulated fibre bar at the base of the controller switch and moved by it.

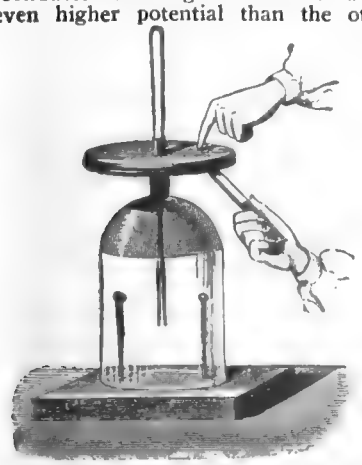
A polarized relay, which may be a home-made one, constructed from a polarized telephone ringer having about 50 to 75 ohms resistance is connected across the wheels of the train and on the locomotive, so as to receive current in one direction or the other according to the polarity of current supplied thru the speed control and reversing switch. If the armature of the polarized relay is set just past the center line, as shown in the detailed diagram, then with the current passing thru the coils in one direction, it will produce north and south polarity in the coils, and if the polarities on the lower pole piece agree, then the armature will remain attracted as shown. Now if the current thru the rails is reversed, a south pole will be set up by the coil in the lower pole-piece, which will neutralize the magnetism of this pole, and cause the upper pole-piece to attract the armature, thus forcing its platinum point against the upper contact screw, permitting current to pass thru the opposite solenoid A_1, which will throw over the reversing switch connected to the field windings of the motors, thus in turn causing the motors to reverse their direction of rotation.

The solenoids actuating the pole-changing switch for the field windings of the motors, may be small ones about 2" in length, and 1" in diameter, with ⅜" soft iron cores. It will be noted in the scheme shown herewith, and as the detailed drawing further elucidates, that when the iron solenoid plunger is sucked all the way into the coils, it causes the light spring contact at the outer end to be opened; thus after the coil has done its work in shifting the pole-changing switch over to one side or the other, as the case may be, the current thru the solenoid is cut off; this eliminates any further waste of energy thru these members.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

The Contact Theory of Electricity

THE contact theory of electricity is one of the older theories, and states that if two dissimilar conductors, such as plates of copper and zinc are brought in contact with one another, a difference of potential will result, one conductor showing a fraction of a volt or even higher potential than the other.



Electroscope Showng Potential Due to Contact of Dissimilar Metals.

This is the simplest case. To make it more complicated, a chain or succession of various conductors such as plates of different metals, may be placed in series, in contact with each other, so that each of the plates will touch only its neighbor or neighbors. If this is done, the potential difference between the terminal plates will be the same *as if they only* were in the set and were in contact, the others being eliminated.

An electroscope comprising a pair of gold-leaf strips has a circular metallic plate horizontally secured above it, in metallic contact with the gold-leaf strips. A second plate of metal with a glass handle and with its lower surface thickly varnisht, when placed as shown on the lower one, establishes a capacity, and the pair form a condenser. The upper plate is earthed, preferably by a metal conductor. The lower one is toucht with one of the constituent metals of a compound bar of copper and zinc.

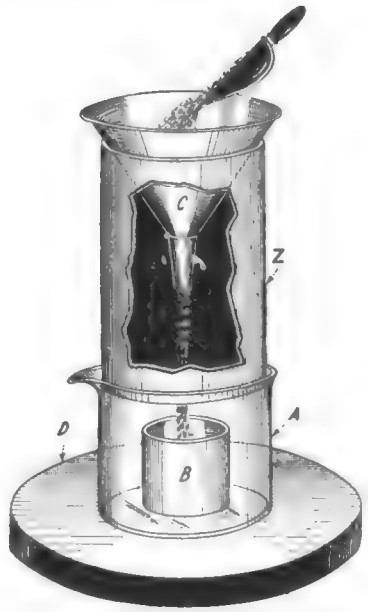
By the contact theory, each metal has its own potential, and when one of them touches the lower plate, it charges the condenser. This has practically no effect on the gold-leaf, because of the large capacity of the two discs, but if the upper plate is removed, the capacity of the condenser is reduced to almost zero, the potential rises and the gold-leaf strips diverge.

Another demonstration of the principle of the apparatus is based on a variation on the torsion electrometer. Referring to the second illustration, C and Z, are two plates, one (C) of copper, and the other (Z) of zinc. Above them is suspended by an insulating thread an index coated with metal foil shaped as shown, one end flat and expanded, the other end counterpoised. The whole is enclosed in a glass bell-jar. A movable brass rod passes thru a hole in the bell-jar so that it can be brought into contact with the index and removed from contact, as desired. It is caused to touch the index and by touching the protruding portion of the rod with a Leyden jar or other source of excitation, a charge is imparted to the index. The rod is then turned so as to be out of contact with the index. If now, the copper and zinc plates are brought into electrical contact by connecting the ends of the wires shown in the cut, each assumes a polarity and the index is deflected.

As many readers interested in this experiment have failed to obtain results, the matter was referred to Dr. T. O'Conor Sloane, and he explained that usually the instruments employed were not sufficiently

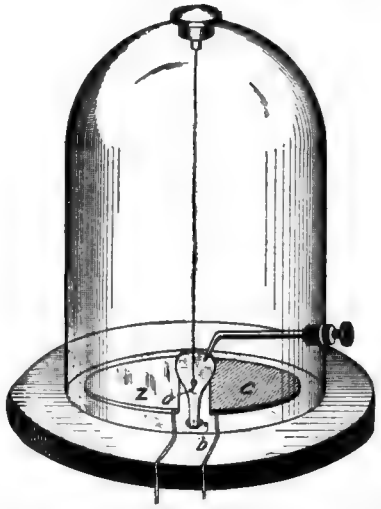
Compound Bar for Showing Contact Action.

sensitive, as the contact electricity produced was mostly potential or voltage and the current or amperage was of infinitesimal value.



Apparatus for Producing Electric Potential Difference by Contact Action.

Carrying this idea still further, Lord Kelvin constructed the apparatus shown in the last illustration. A cylinder (Z), of zinc contains a copper funnel. Below the funnel is a cup of copper. The whole apparatus stands on a glass insulating base, and the copper cup is insulated from the rest of the apparatus. On pouring copper filings into the funnel, they stream down



Torsion Electroscope for Showing Contact Action.

into the cup below, and as zinc is in contact with copper, they carry a charge so that the insulated cup acquires a potential.

What has been described, is designed to show the *contact potential* of solid and dry conductors. The experiments can be developt to include liquid electrolytes—the whole gist of the matter being purely theoretical, to give a basis to establish the rationale of the action of the galvanic cell. There is nothing of practical value in it, and it is not even certain that the potential difference is due to the solid conductors alone.

The following table gives the differences of potential between some of the more common metals and carbon.

Difference of Potential (Volts)

Zinc	
Lead	0.210
Tin	0.069
Iron	0.313
Copper	0.146
Platinum	0.238
Carbon	0.113

If we add the six potentials together, the result is the potential difference between zinc, the first of the metals, and carbon at the foot of the list. It is 1.089 volts. The difference of potential between any two metals is equal to the sum of the differences of potentials between the intervening metals in the contact series.

Mending Cracks in Glassware

A VERY novel way of mending cracks in glassware has been recently introduced. By means of this plan it is possible to make the articles just as they were when they were new. The work is very interesting and it is not at all difficult to carry out.

For the purpose a small amount of sodium silicate or waterglass is needed. This material can be secured from any chemist and, as is well known, it is largely employed in the preserving of eggs.

Where the cracked object is a decanter, a bottle, or anything that has a stopper, or can be provided with a cork, proceed in this way: Take out the stopper and hold the bottle in front of a stove until it is quite warm. Then replace the stopper and without delay, get to work with the waterglass. This is painted all along the crack with a brush, care being taken to put it on rather thickly. After a little while the air in the bottle begins to cool down and then a very singular thing happens. The pressure of the atmosphere outside forces the water glass into the crack and the ugly line disappears as if by magic. Leave the bottle for a few hours so that the waterglass may set hard and then wipe away any surplus where the crack has been with a sponge and very hot water. The bottle will then be just as good as ever it was and will hold liquids.

Where the article is a wide-mouthed jar or bowl a somewhat different line of procedure is needful. Take a basin and, in the center of this, put a lighted candle end. Now pour about an inch of water into the basin and place the cracked jar in an inverted position over the light. As soon as the air is exhausted inside the light will naturally go out. Without any delay paint on a thick layer of the waterglass all down the crack. Exactly the same thing happens as was noticed previously. The pressure of the atmosphere outside forces the waterglass into the crack and the line disappears. Thus the jar is perfectly mended and no sign of damage can be discerned. Drinking tumblers which have been cracked can be treated in just the same way only in these cases a short piece of candle should be used such as will conveniently go under the tumbler.

Contributed by S. LEONARD BASTIN.

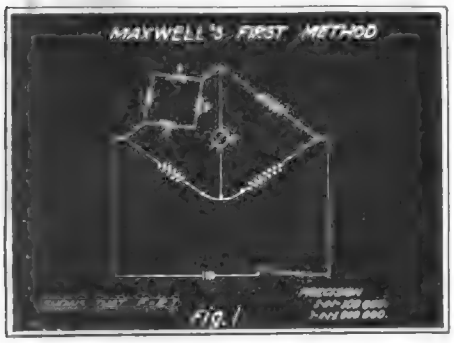
Digitized by Google

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Is Ohm's Law Valid?

By C. A. B. RIGGS

NINETY-THREE years ago, Professor Ohm, as the result of experimenting with the primitive facilities then available, announced the relations existing in a conductor carrying an electrical current,—between the *current, electro-motive force,* and *resistance;* thereby formulating the law which now bears his name. Ohm's law now comes first in the ritual of things electrical, and to the novice it presents, usually for the first time, a glimpse of the fact that all electrical phenomena obey fixt rules,—laws that are embodied in exact mathematical expressions.



The First Method of Maxwell, Used in Checking Up the Validity of "Ohm's Law." Four Equal Resistances Are Measured Separately in a Wheatstone Bridge, and Are Then Connected in Series-Parallel, as Shown, Giving the Same Resistance as One of the Elements Separately. No Error in the Law Was Found.

Ohm's law states, that in a metallic conductor of a given physical state, i. e., *where the temperature and dimensions remain constant, the electrical current flowing will be directly proportional to the electromotive force imposed.* In terms of the units of electrical measurement which are now in use, it can be stated, that, in a conductor, the current flowing in amperes is equal to the e.m.f. or potential in volts, divided by the resistance in ohms. This is really an experimental law and is not deduced as the inevitable consequence of a theory. It is a simple law. Moreover, it is of fundamental importance to the electrical engineer, the electrical experimenter, and the physicist.

How exactly does this law hold? With the great refinement of the facilities of investigation of the present day, is it not possible that Ohm's law may be found to vary ever so slightly from the exactitude of the mathematical form in which it is presented? In other words, may it not be found possible that the resistance may change just a little in a conductor, in varying the current from a small value to one of greater magnitude?

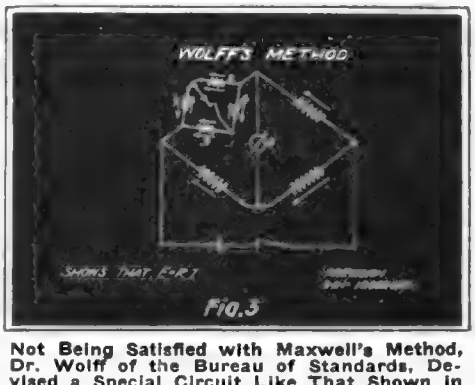
Recent experiments indicate that Ohm's law holds to a high degree of exactitude, no departure being observed in employing the refined methods of testing now available. This subject was discust by Dr. Frank Wenner of the Bureau of Standards, in a paper before the American Physical Society this spring. The statements of Dr. Wenner are of especial interest on the subject, as he is a high-priest in the Temple of Standards, at Washington—the Keeper and Dispenser of the Sacred "Ohm." He has charge of the work of standardizing electrical resistances, and is specially qualified to discuss the subject.

According to the speaker, about fifty years ago a committee of the British Association was appointed to investigate the accuracy of Ohm's law. Maxwell was chairman of this committee, and he devised two methods for making the tests, both of which were capable of giving high precision. No departure from the law was then found.

The first method was thought to give a precision of one part in 100,000, and the second was supposed to be good to one part in 1,000,000,000,000 or one part in a million million. On account of the relatively higher accuracy of the second method, little weight was given to the results of the first. However, it now appears, according to Dr. Wenner, that the first method was more fundamental in character than the second, and this was discust in connection with figures which appear with this article.

In Figure 1 is shown the first method of Maxwell. In this method four substantially equal resistances are measured separately in a Wheatstone bridge; and are then connected in series-parallel, as shown, giving the same resistance as one of the elements separately. If a departure from Ohm's law, perceptible by this method, existed, it would become apparent by a discrepancy between the resistance of the four, measured in series-parallel, and as computed from the resistance as determined separately. This was not found.

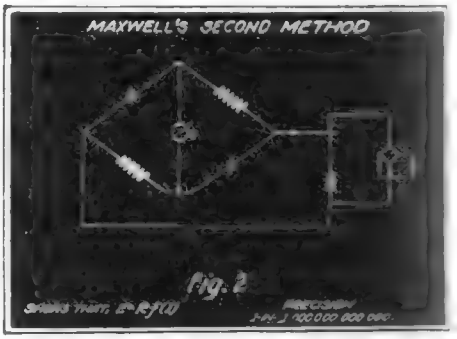
The second method is shown in Figure 2. Here the bridge is so arranged so that in each branch there is provided one long thick conductor and one short thin conductor, with the result that the current density in each conductor of a branch will be different. In this experiment it is assumed that if the current applied to the bridge is changed then a variation from Ohm's law would cause the balance of the bridge to be upset. The key arrangement and the two battery systems shown, one with a reversing switch, is for changing the current from one value to another very quickly. The key is operated many times a second, for the purpose of switching back and forth, so that temperature conditions will remain constant in comparing the effects of the two currents.



Not Being Satisfied with Maxwell's Method, Dr. Wolff of the Bureau of Standards, Devised a Special Circuit Like That Shown in Figure 3, Giving an Accuracy of One Part in 3,000,000. This Precision Test Once Again Demonstrated the Exactness of Ohm's Law.

Proposed Method for Checking the Validity of Ohm's Law Suggested by Dr. Wenner of the Bureau of Standards. In This Case, Both Direct and Alternating Currents Are Used, in Connection with a Special Wheatstone Bridge. The Precision Attained Would Be One in 100,000,000.

This method in Maxwell's hands showed no departure from Ohm's law. The speaker stated, however, that this method was not an absolutely conclusive one, in that the resistance could vary according to certain special mathematical laws, and the balance of



Maxwell's Second Method of Checking the Validity of Ohm's Law Is Here Shown with a Wheatstone Bridge Arrangement, Prepared to Show That E Equals R I (I).

the bridge would be maintained with different current densities.

Maxwell's first method was used by Dr. Wenner with modern apparatus, giving an accuracy of one part in 1,000,000, and no departure from Ohm's law was found.

Another method, proposed by Dr. Wolff of the Bureau of Standards, was also tried. This was capable of giving an accuracy of one part in 3,000,000. The connections are shown in the diagram of Fig. 3. In this a Wheatstone bridge equipt with a battery in the position ordinarily used for the galvanometer, is placed in one of the arms of another Wheatstone bridge. By a suitable balancing of resistances, the galvanometer of the large bridge was so arranged that when either of the two battery keys, shown, controlling the battery circuits, were closed separately, the galvanometer did not deflect. Both keys were then closed at the same time, and the fact that no deflection was produced indicated that Ohm's law held.

Dr. Wenner then showed the diagram for a new method devised by him which was yet more sensitive. This is indicated in Fig. 4. In this case direct and alternating current are used. As before, one Wheatstone bridge was arranged to form an arm in another bridge. An alternating current is arranged to be supplied to the cross connection of the little supplementary bridge, and another alternating current of just twice this frequency is used to excite the field coils of a alternating current galvanometer, placed across the arms of the large bridge. A direct current battery with a contact key is arranged at the terminals of the large bridge. By a suitable adjustment of the resistances, the bridges are balanced when either the alternating current or battery current is applied separately. The direct current and the alternating current are then to be applied simultaneously, and if there is any variation from Ohm's law detectable it will be shown by a deflection of the galvanometer. With this arrangement a sensitiveness of one part in 100,000,000 is predicted.

Dr. Wenner, with conventional scientific caution, stated that from his experiments Ohm's law was found to hold for the conductors which were used in the investigation, but he was not making any assumptions respecting what might be found with other conductors.

In the course of the next year it is planned to obtain results with the last-mentioned method and with other materials.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

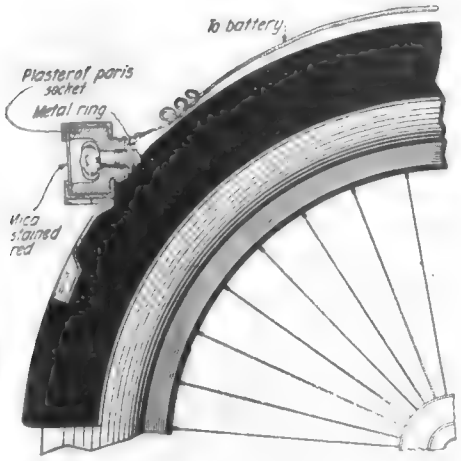
ELECTRIC BICYCLE TAIL LAMP.

Very few people have thought that an old fuse plug would make a very good bicycle tail lamp, but nevertheless, it does. First it will be necessary to remove the mica shield from the fuse plug. In some of the separable plugs this is rather easy; the mica shield is painted red and constitutes the "lens."

The bottom contact of the fuse plug will then have to be removed and scraped larger whereupon a tiny bulb is put into position and locked from the outside by a washer. A wire can be soldered to the washer and led to the battery and the other contact takes place thru the bottom of the bulb where it will touch the mudguard of the bicycle.

The fuse plug is then fastened to a piece of fiber and locked in place on the mudguard as shown in the illustration. A battery is suspended from the frame of the bicycle.

FRANCIS DONNELL.



Here Is the Way to Construct a Real Tail Lamp for Your Bicycle or Motorcycle,—the Lamp May be Lighted from a Battery or Dynamo.

PAPER BUTTERFLIES THAT FLY.

Here is a charming little experiment that can be carried out by means of a Seidlitz powder, one of the last things in the world from which one would expect any amusement. Secure an empty jam jar and get a good-sized cork to act as a stopper to this. In the centre of the cork bore a hole thru which opening a funnel is pusht. The way in which this is done can be seen from the sketch. Next, from brightly colored tissue paper, cut the shapes of three or four butterflies. In the middle of each of these, just between the wings, fasten with glue a thin strip of cork. This serves to act as a body for the paper insect and also helps in the balance of the butterflies when they are in the air.

Fill the jar about half full with water. Then, into it, tip the contents of the packets forming the Seidlitz powder. Quickly replace the cork in the jar and put the paper butterflies into the funnel. Soon the gas generated by the effervescence rises and this causes the butterflies to fly up and down in a most life-like manner. The effect continues for quite a good while seeing that the comparative smallness of the opening of the funnel only allows a little of the gas to pass out at a time. This is all sufficient to keep the butterflies flitting up and down in a most fascinating manner.

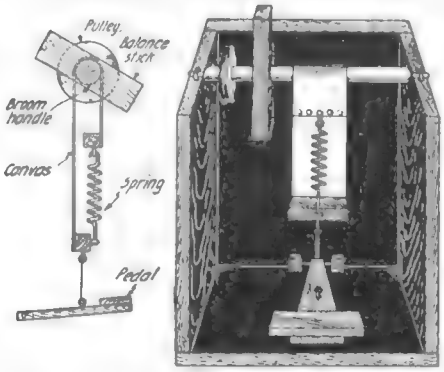
Contributed by S. LEONARD BASTIN.

The Paper Butterflies Seen in the Accompanying Illustration Are Caused to Flit About By the Action of a Seidlitz Powder Dissolving in Water.

SECOND PRIZE, $3.00

A MECHANICAL WHIP MOTOR.

In the diagram shown here, we see the constructional details of a mechanical whip motor. A shaft is made from a broom handle to which the balance stick and pulley are attached. A strip of canvas belting, whose ends are now nailed to two blocks of wood, is passed over the broom handle, and one end is connected to a spring and the other end and the spring are connected to a pedal.



One of the Latest Discoveries in Mechanical Science Is the So-called "Whip" Motor. The Author Shows Above How to Construct a Simple Whip Motor Which May be of Considerable Size, Depending Upon the Strength of the Parts and the Power Available to Operate the Pedal.

When the pedal is moved up and down rapidly, a speedy little motor is the result which does not, however, give much power. This same principle will work on a much smaller scale by using rubber bands and thin tape instead of the canvas, in which event the motor may be actuated by hand.

Contributed by
ARMARD MOTSINGER.

THIRD PRIZE, $2.00

A "TWO CENT" HYDROMETER.

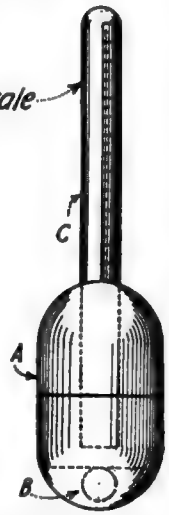
This is a very simple, easily made hydrometer and accurate enough for all ordinary purposes. Two bottle corks, ½ inch in diameter and an inch long, are glued together as shown at A. Then a hole is drilled in the bottom, a lead bullet, B, inserted, about 38 caliber answers the purpose nicely. Now push a piece of steel, C, an old corset steel is suitable enough, about 7 inches long, into the top. Paint the whole thing with a good coat of asphaltum thinned with turpentine.

To make the scale. Take a standard hydrometer and immerse it in a test solution made up so that it sinks until it registers O, then insert the two-cent homemade hydrometer into the same solution and mark it with white enamel just at the line. Then add more salt to the solution and continue graduating it until the scale is complete.

I have a set made for acid, oil, gasoline, alkali, etc., twelve in all, and the actual cost of making the twelve was only ten cents, while if I had purchased them they would have cost $13.00.

You can undoubtedly borrow hydrometers for the purpose of making the scale on these homemade ones from your local pharmacist or garage owner.

Contributed by
EVERHART TURNER



Who Would Not have a Hydrometer When One Can be Constructed as Simply as This One,—Which Consists of Two Corks and a Piece of Corset Steel? Do Not Use It in Your Storage Battery!

Glass tubing, united by this means, will separate at any other point sooner than at the point of junction.

Contributed by J. H. K.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

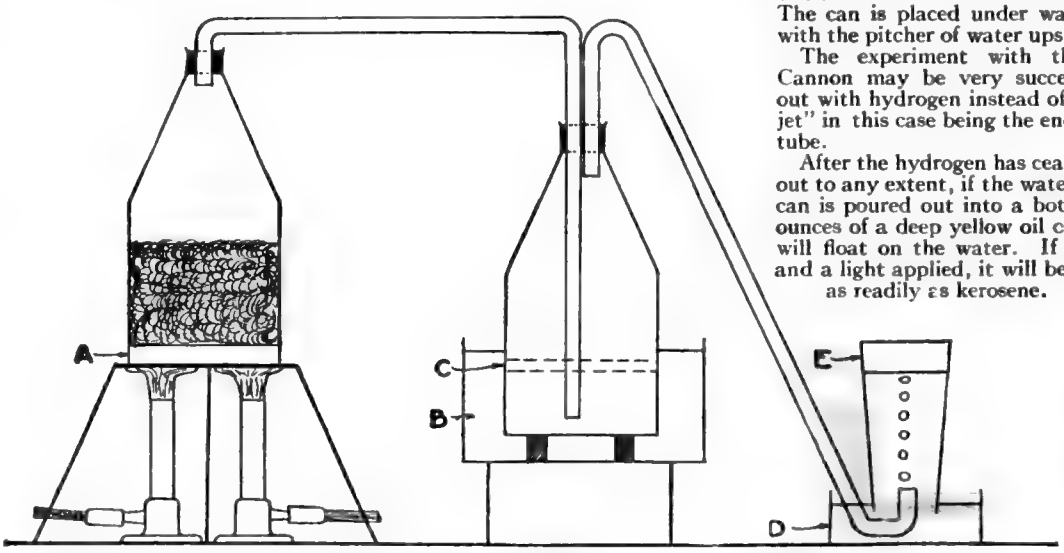
Fascinating Experiments in Chemistry

By O. IVAN LEE

How to Make a Burning Gas (Hydrogen) and a Burning Oil from Castor Oil.

CASTOR oil, of unpleasant memory to many of us, is an extremely complicated substance chemically, and a great variety of interesting and useful things may be made from it, depending upon how it is treated. Among these is the wonderful gas hydrogen with which balloons are inflated.

The apparatus required is a couple of quart tin cans, a fire to heat one of them, another larger tin can with the top cut out, a water basin, a glass pitcher (or large olive bottle), and three glass or metal "L" tubes with some rubber tubing for making connections. One of the "L" tubes has one long arm, the other, two. Connect the two tin cans as indicated in the drawing, making one of the long arms of the second "L" tube extend nearly to the bottom of the second can which is half filled with water. An outlet connected to a couple of feet of rubber tubing is made with the third "L" tube and leads from the second can to the water basin. This is partly filled with water. Drill the corks used carefully, and make all the connections air-tight.



Apparatus Set Up for Making a Burning Gas (Hydrogen) and a Burning Oil from Castor Oil.

Set the second can in the larger can and pour water into the space between. This is for cooling purposes.

Into the first can put one and a quarter ounces of water and two ounces of soda-lye, warming the mixture till the lye is dissolved. Then add half a pound of castor-oil. (The prevailing price for this is 21c a pound, but this will vary with the place of purchase), connect up the apparatus again and light the fire under the first tin can. To avoid direct contact of the flame with the bottom of the can, put a piece of sheet iron or common tin under it. Soon after the fire is lighted, bubbles will be noticed coming from the end of the rubber tubing in the water. These are bubbles of air driven out by expansion, due to the heating. A little later, some white smoke may appear with a peculiar sweetish odor. When the bubbles begin to come at a more rapid rate, fill a long slender vial or bottle with water. Cover the end with your finger and turn it upside down with the mouth under the water in the basin. Now catch some of the bubbles coming from the end of the rubber tube. The water in the bottle will rapidly be driven out. When this has occurred, place your finger over the mouth of the bottle again, strike a match, and holding the vial pointed away from you, apply the flame of the match as soon as you remove your finger. Very likely you will hear a sharp "pop" and you may see a little flame flash down inside the bottle. On the other hand, if nothing happens, only air is coming out and not air and hydrogen, which *together* are explosive. Hydrogen alone burns but will not explode, so when the air has been all pushed out by the hydrogen, a sample of gas caught and burned as described will burn quietly. If you watch closely you may see the hydrogen flame as it sinks down into the bottle forming perhaps a ring.

Apparatus Used in Performing "Spontaneous Combustion" Experiment.

No attention need be paid to any white smoke which may accompany the hydrogen gas as it will disappear on letting the gas stand over water. A larger volume of hydrogen may be trapt and stored in the water pitcher, which is to be supported by an inverted tin can with a small hole cut in the bottom, and another near the rim of one side for the insertion of the gas-tube. The can is placed under water, of course, with the pitcher of water upside down on it.

The experiment with the Powderless Cannon may be very successfully carried out with hydrogen instead of gas, the "gas-jet" in this case being the end of the rubber tube.

After the hydrogen has ceased to be given out to any extent, if the water in the second can is poured out into a bottle, about two ounces of a deep yellow oil of peculiar odor will float on the water. If it is removed, and a light applied, it will be found to burn as readily as kerosene.

"Spontaneous" Combustion.

In the first place, there is no such thing as "spontaneous" combustion. If a fire starts, there is always a perfectly good reason for its starting, altho it may be very puzzling if all the facts are not known. What is meant then, is that the mysterious fire starts apparently without any direct human aid, but since nature is always "on the job," there is no magic about the matter. The whole term is based on popular ignorance of natural laws, of the kind which leads some to waste their time and money trying to discover "perpetual motion."

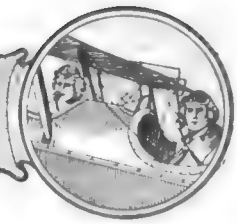
A striking demonstration of the kind of combustion whose origin would be conveniently described by the newspapers as "spontaneous" may be made with ten cents worth of chemicals obtainable at any drug store—five cents worth of glycerine and the same amount of permanganate of potash. This last is a dark violet crystalline substance of which a minute particle will color a glass of water a beautiful purple.

Rub a half teaspoonful at a time between two flatirons until it is a fine powder. Collect a couple of spoonfuls into a little heap on a slab of stone or iron, and make a slight depression in the top of the heap. Now quickly drop about a dozen drops of the thick, sweet and harmless looking glycerine into the little hole in the heap of powdered permanganate. For a moment you'll be disappointed—nothing seems to happen. Then—signs of action!

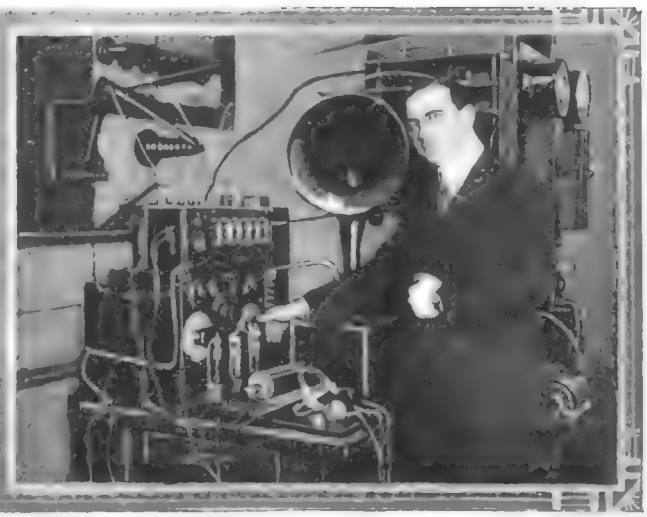
(*Continued on page* 1328)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

RADIO DEPARTMENT



Radio "Talk" Relayed to Land Lines



A Remarkable Demonstration of a New Wireless Stunt Perfected At the City College of New York, Was Given Recently by Professor Alfred N. Goldsmith, Here Shown in His Laboratory At the College. Through a Megaphone Attachment the Wireless Gossip of the World Was Heard by Those Who Witnest the Demonstration.

RECENTLY there was carried out at the radio laboratory of the College of the City of New York some extremely interesting tests in which radio-telephone "talk" was transferred to land lines and vice versa, at will. When interviewed at the Radio Laboratories of the College of the City of New York, concerning these tests, which were under his supervision, Professor Alfred N. Goldsmith, in charge of Electrical Engineering, said:

It is natural that the recent remarkable achievement of the American Telephone and Telegraph Company in enabling persons on board a ship on the Atlantic Ocean to talk by wire and by telephone to persons or individuals on the Catalina Islands in the Pacific Ocean should have aroused such widespread public interest.

This transmission of the human voice over thousands of miles of wire and thru many miles of air has been made possible by the development of a new type of vacuum tube frequently known as the *audion*. It resembles in appearance a large lamp and contains a glowing filament and special forms of metallic grids and plates. This tube can take the extremely feeble speech and raise its loudness by electrical means until tremendously loud speech is produced. When it works in this way, it is known as an *amplifier*, and as such is widely used in wire telephony and in radio communication. It can also be used in a number of other special ways for radio telegraph and telephone transmission and reception, and is largely employed for these purposes today.

Radio-telephony has long been a subject for special investigation in the Radio Laboratories of the College of the City of New York. The first experiments were carried out more than twelve years ago with what is known as the *Poulsen Arc* apparatus and covered only short distances. However, by 1916, a powerful vacuum tube radio-telephone set had been installed in our Laboratories at the College and gave excellent results. It was much the same type of apparatus as is used today for the same purpose.

There was stretched over the buildings of the College a great aerial wire system for transmitting, with more than three-quarters of a mile of heavy bronze wire in it. Thousands of feet of broad copper band were buried in trenches under the College lawns to afford a proper connection to the earth.

The results that were obtained at the College more than five years ago justified the trouble taken. We telephoned from a downtown residence more than seven miles from the Laboratory over the wire lines and then *automatically transferred* or *relayed* the received speech out by radio-telephone. That is, the wire telephone was automatically linked with the wireless telephone and every word spoken downtown went out by radio from our transmitter.

This speech was heard as far away as North Dakota, over 1,300 miles from New York. At shorter distances the loudness of the speech was so considerable that some amusing incidents occurred. For example, a radio amateur some 50 miles from the College happened to "tune in" our speech signals one evening. He afterwards explained that he thought his aerial wires had either fallen across an electric power line or been struck by lightning, judging from the tremendous volume of the speech received.

This pioneer work of five years ago has been carried forward steadily in the Radio Laboratories of the College and about ten different types of radio-telephone transmitters of various sizes have since been produced and successfully tested here.

The American Telephone & Telegraph Company has been interested in radio-telephony as a useful adjunct to its highly successful wire service under special conditions for a number of years.

In 1915 elaborate experiments were carried out by that Company and the Western Electric Company, with the co-operation of the United States Navy, at the Arlington, Virginia, radio station of the Navy. The great aerial wire system at Arlington supported on 600-foot steel towers was placed at the service of the Companies for experimental purposes. A radio transmitter was installed in which as many as 550 of the transmitting tubes were used at a time. Speech from various points was carried by wire to Arlington and then sent out by radio automatically. The voice of the speaker was heard at points as widely separated as Paris, France; Mare Island in the Pacific Coast; and Honolulu.

The promise shown by these experiments encouraged the Telephone Companies to carry the work further and they determined to try out thoroly radiophone communication between ships and shore, and between islands and the main land. Accordingly, the steamship *Gloucester* was equipt with an efficient radiophone set. Furthermore, two land stations were established, one at Green Bay near Boston, and one at Foxhurst, N. J., near

Articles to Appear in April Issue of "Radio News"

Aeroplanes and Radiogoniometers by Armstrong Perry.

Simple Measurements and Calculations for the Radio Station Owner by P. F. Geagan.

A Long Range Receiver by Joseph G. Read.

A Honeycomb Coil Tuner by Paul Watson.

Short Wave Radio Vacuum Tube Transmitter and Regenerative Receiver With Two-Step Amplifier by Walter Hyndman.

A Two-step Audiotron Amplifier by Frederick J. Rumford.

Tug or Spirit—a Fascinating Story by Julian K. Henney.

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

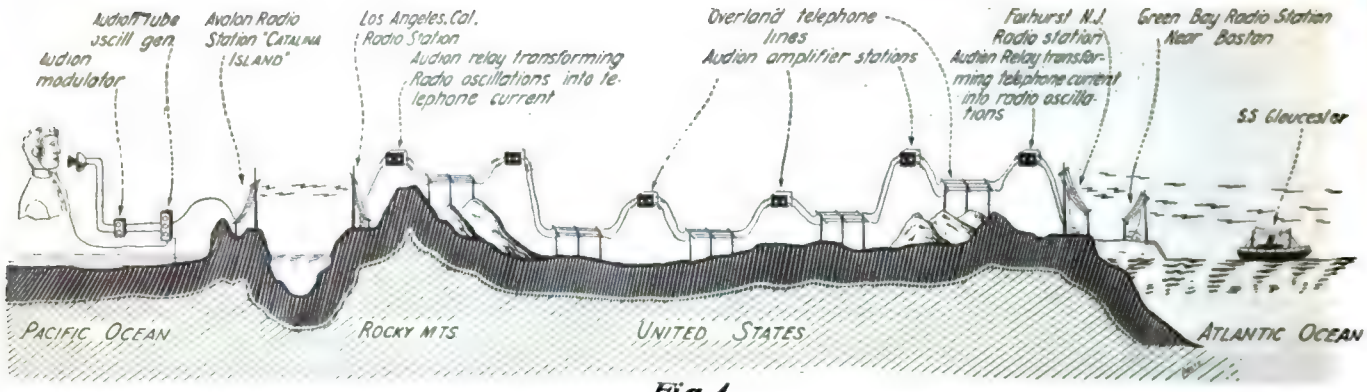


Fig. 1

Fig. 1. Physical Diagram Showing the Combined Wireless and Wire Telephone Conversation Recently Carried Out Between a Radio Station At Avalon, Catalina Islands, Off the California Coast, and the Steamship "Gloucester" Off the Atlantic Coast. This Diagram Shows How a Person At Avalon, Off the Pacific Coast, Talked First by Telephone Then by Radio and Then Again by Telephone, Over the Famous Transcontinental Telephone Circuit Equipt With Audion Amplifiers As Shown At Successive Stages of the Journey and Finally the Telephone Currents Corresponding to the Human Voice Were Converted Into Radio Oscillations and Ether Waves At the Atlantic Coast Stations, Whence the Messages Were Wafted Thru the Ether to the S. S. "Gloucester."

Elberon; these points being near the terminals of the coastwise trips of the *Gloucester*. These sets were all transmitting tube sets and were *duplex* sets. That is, it was possible to send and receive at the same time and the users of these sets could therefore *talk and listen simultaneously*, just as on an ordinary telephone wire line. The Foxhurst and Green Bay radiophone stations were then connected to the wire line systems of the Telephone Company.

About the same time, radio telephone sets were installed at Los Angeles, California and Avalon, Catalina Islands. The stretch of the Pacific Ocean lying between Avalon and Los Angeles was very successfully bridged, and many thousands of calls have been handled without trouble.

Recently, the operator on the *Gloucester* established communication with Foxhurst. There his speech was automatically transferred to the transcontinental line terminating in Los Angeles, where it was again transferred to the radio-telephone and carried to Avalon. So that the operator at Avalon and the operator on the *Gloucester* were in direct personal touch.

While the radio-telephone is not regarded as a competitor of the wire telephone for ordinary overland communication, it is, nevertheless, a useful adjunct in such special cases as those just described and forms an excellent element in the system of any effective public service wire communication company.

The *Gloucester-Avalon* transmission is interesting from another point of view. For the first time in the history the voice of man has been carried across portions of two oceans and an entire continent!

In view of the ease with which the wire service and the radio-telephone can be linked to each other, it is clear that every telephone subscriber in the United States automatically becomes a subscriber to such special radiophone service as may be established by the wire companies and their associated companies.

Clearly, the time is not far distant when, by asking for "radio long distance" or possibly radio marine service any telephone subscriber will be able to reach ships at sea or possibly even telephone subscribers on the other side of the ocean.

The work done in radio research at the College of the City of New York enabled its staff to render valuable service to the Army and Navy during the war. Many hundreds of men were trained for the Navy in a special school established at the College, under the general direction of Professor Frederick B. Robinson, Dean of the School of Business and Civic Administration, and under the engineering charge of myself. The purpose of this School was to teach the Navy's operators how to handle radio direction finders or "radio compasses," as they were called. This interesting device enabled stations equipped with it to find the direction of any station which they heard. Not only

(*Continued on page* 1349)

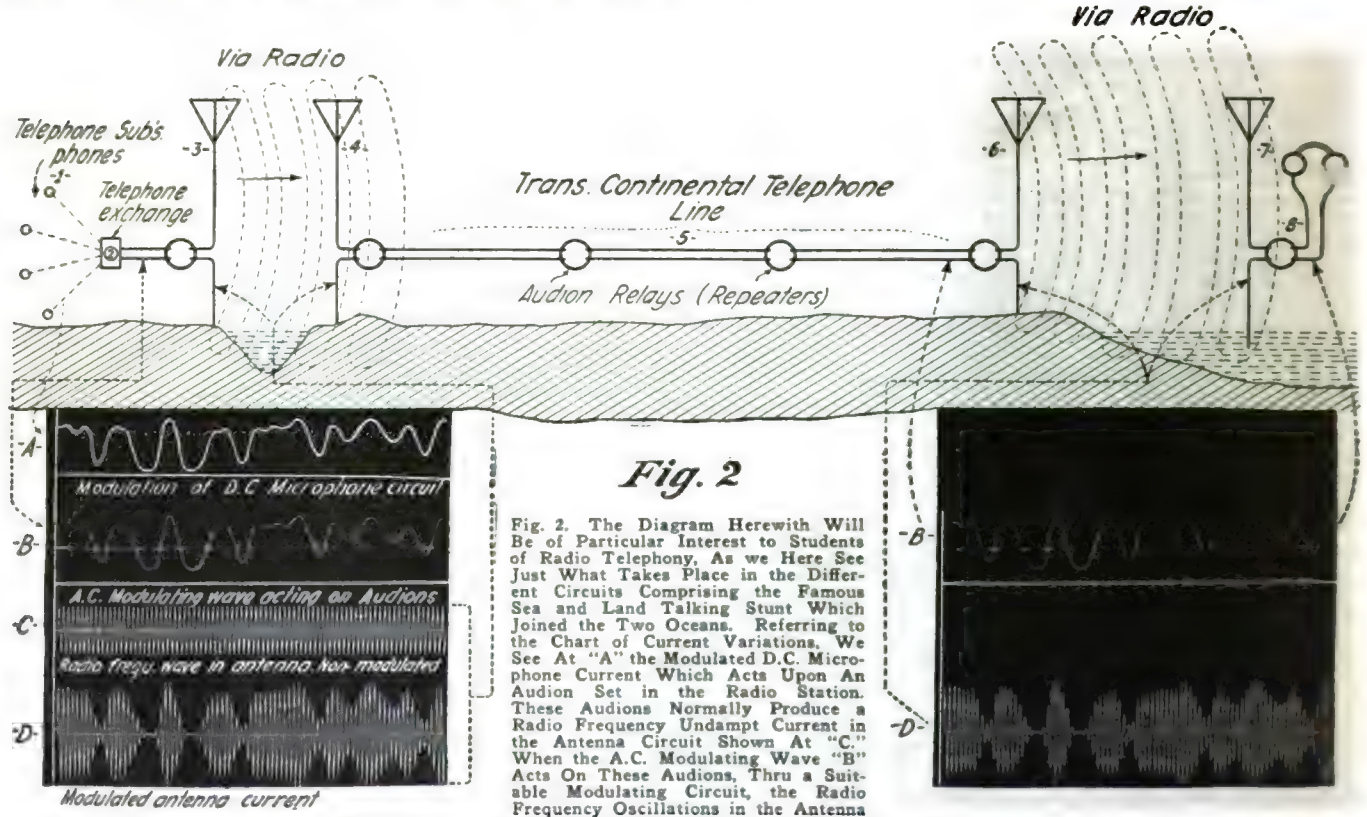


Fig. 2

Fig. 2. The Diagram Herewith Will Be of Particular Interest to Students of Radio Telephony, As we Here See Just What Takes Place in the Different Circuits Comprising the Famous Sea and Land Talking Stunt Which Joined the Two Oceans. Referring to the Chart of Current Variations, We See At "A" the Modulated D.C. Microphone Current Which Acts Upon An Audion Set in the Radio Station. These Audions Normally Produce a Radio Frequency Undampt Current in the Antenna Circuit Shown At "C." When the A.C. Modulating Wave "B" Acts On These Audions, Thru a Suitable Modulating Circuit, the Radio Frequency Oscillations in the Antenna Are Molded to Resemble Those at "D." The Antenna Current Received At the Antenna 4, for Example, Resembles the Groups of Oscillations "D," Which Are Transformed Thru An Audion Receiving Set, Into Telephone Currents Similar to Those At "B." At the Atlantic Coast Radio Station, 6, for Instance, These Telephone Currents "B," Are Again Changed Into Modulated Radio Frequency Currents "D." The Electro-Magnetic Waves From Antenna 6, Reach the Antenna of the Ship Station At 7, Where Radio Frequency Currents Are Set Up in the Antenna Resembling "D." The Currents in the Antenna 7 Pass Down Thru An Audion Receiving Set and Into the Telephone Receiver Circuit, Where An Audio-Frequency Current As At "B" Is Heard by the Operator. It Was Possible for Conversation to Be Carried on Both Ways Without Switching From Transmitting to Receiving, in the Recent Telephone Tests—the Person Both Talking and Listening in the Same Natural Manner As When Using a Common Bell Telephone.

Digitized by Google
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

The Audio-Frequency Amplifier in France

By ROBERT E. LACAULT

Late Lieutenant in the French Army Signal Corps

VERY little has been said about the researches made in France on the subject of Radio and especially on the apparatus using V. T. (vacuum tubes), for most of the experiments were carried out during the war

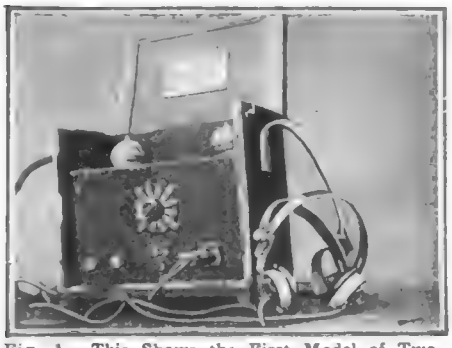


Fig. 1. This Shows the First Model of Two-Stage Audio-Frequency Amplifier Developed for Use by the French Army.

in the laboratory of the Signal Corps, and until peace was signed, nothing could be divulged to the public.

The writer, who has carried out several experiments in this laboratory, is pleased to present to the readers of SCIENCE AND INVENTION some new facts on the birth and growth of the amplifier in France.

It was in 1915 that the need for a sensitive and practical amplifier was felt in the army for until that time spark transmission was used, and the reception was effected on a crystal detector. At this time, some officers who were sent to this country, brought back a few models of V. T.'s, which were practically unknown in France. Immediately experiments were made by the most prominent French radio engineers and a few months later a standard type of V. T. was adapted and manufactured by two firms which produced *5000 tubes a day;* it must be added that a great number were broken at the front every day owing to the bombardments, which explains why this number was only just sufficient.

This standard type of V. T. was so designed that it could give equally good results when used as a detector or an amplifier as well as an oscillator. At the same time research was made to find the best characteristics of an amplifying transformer which was to be used in conjunction with the standard V. T. The result of this work was a two-stage audio-frequency amplifier especially designed for field work. This amplifier is shown in Fig. 1.

Catching the German Conversations

As soon as amplifiers were brought to the front the officers of the Signal Corps tried to use them to catch the conversations carried on over the telephones in

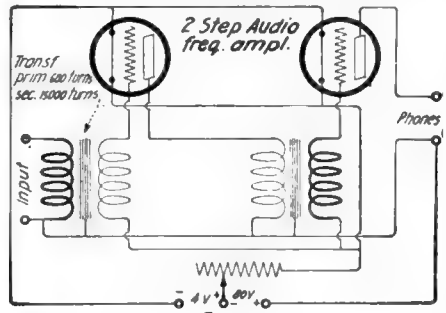


Fig. 2

Fig. 2. Connections Used in Two-Stage Audio-Frequency Amplifier Used Considerably in Trench Radio Sets by the French Army.

the German trenches. These attempts were quite successful and it was found that by running two wires parallel to the German 'phone lines along the ground, it was possible to hear every conversation of the enemy, and thanks to the ultra-sensitive amplifier the inductance was sufficient even at a great distance from the lines to accomplish this successfully. It is needless to add that very important information was obtained by this system.

When no telephone was used by the enemy, a microphone (like that used in a dictagraph) connected to an amplifier was brought near the German trenches during the night and some useful and interesting data for the Allies was gleaned from the overheard conversations.

The amplifiers have also been extensively used in the ground telegraphy system. This ground radio merely effects the transmission of waves in the earth and is very simple. The transmitter is a powerful buzzer operating on 10 volts and the receiver is an audio-frequency amplifier; the radiating system is made of two wires grounded at the ends. This ground telegraphy was especially useful where it was impossible to erect an aerial, and a range of about three miles was obtained with a power of only 20 watts. Fig. 8 illustrates this system.

After this short review of these generally unknown uses of the amplifier we will speak of its use in Radio-telegraphy. With the new warfare it was often impossible to use in the trenches the heavy powerful spark sets which were supplied to the Signal Corps. It was therefore, decided that small portable sending sets should be built which could be carried by one or two men and which could be erected or dismantled in a few minutes. But owing to the small power of these stations it was necessary to use very sensitive receivers.

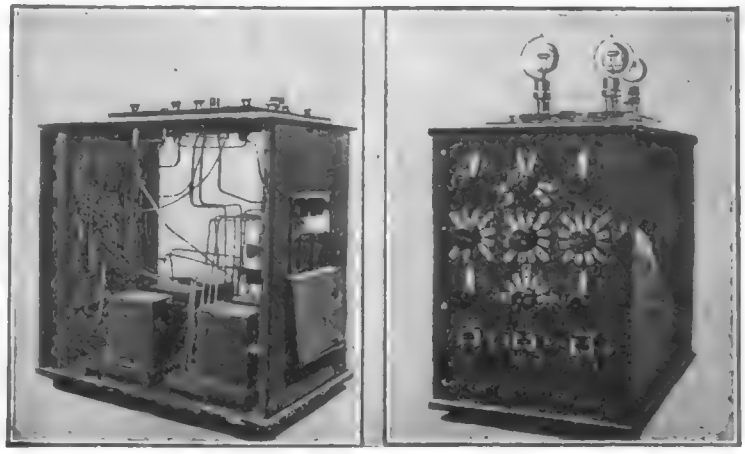


Fig. 3. Regular Model Three-Stage Audio-Frequency Amplifier Which Can Be Used When Desired As a Detector and Two-Stage Amplifier. The Photo Shows the Front View of Switch Panel with Three Jacks for Telephone Receiver Plugs As Well As Interior View of the Cabinet with Wiring, Self-Inductance Coils and Transformers.

The amplifier shown in Fig. 1, was at first used with the receiver of the portable sets and has made long distance communication with low powered transmitters and low aerials possible; the question of Trench sets was therefore solved. As can be seen in the diagram Fig. 2, this apparatus was rather simple. Later a new model fitted with the latest improvements came out of the laboratory. It was a three-step amplifier equipt with a switch, whereby the first tube could be used as a detector for Radio reception. With this apparatus wonderful results were obtained and a great number of these amplifiers have been manufactured for the Signal Corps. This instrument is shown in Fig. 3 and the diagram of the same in Fig. 4.

Altho this model of amplifier was the best ever designed it was found that owing to its size, it was not very practical for trench work, so the former apparatus was modified again and a new model known as the "3-ter" type was produced which was much simpler, but with which the same value of amplification was obtained. Fig. 5 is a photograph of the Standard amplifier now used in France, and as can be seen only one rheostat is used to control the current in the filament

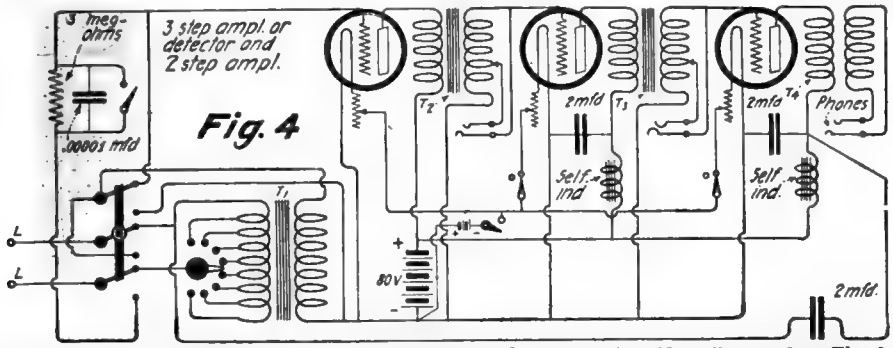


Fig. 4. Wiring Diagram for the Three-Stage Audio-Frequency Amplifier Illustrated at Fig. 3. As Will Be Seen, the Switches Permit the Operator to Employ the First Bulb As a Detector and the Remaining Two Bulbs As Amplifiers in Conjunction with a Crystal or Other Detector.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

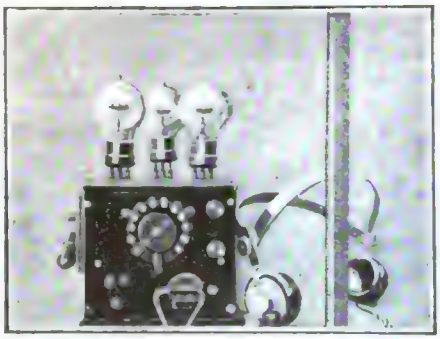


Fig. 7. This Shows One of the Smallest Three-Stage Audio-Frequency Amplifiers Ever Constructed, Possibly. It Was Built by the Writer of This Artilce, and All of the Apparatus Is Combined in a Wonderfully Compact Manner, So As Not to Waste a Bit of Space. The Cabinet Containing This Set Measures But 6"x6"x 6". The Switches Permit the Use of the First Vacuum Tube As a Detector with Two Stages of Amplification, or of Three Bulbs, to Be Used As Amplifiers. The Author States That He Has Accomplisht Just As Good Work with This Set As with the Large One Illustrated at Fig. 3, Which Measures About Four Times Its Size.

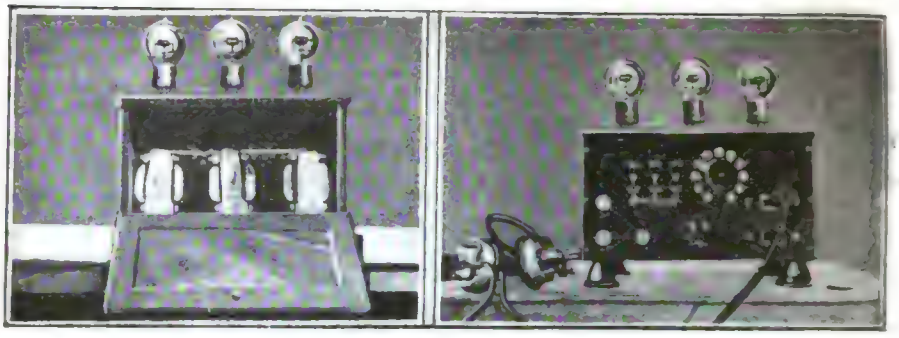


Fig. 5. These Two Photos Show One of the Later Models of Three-Stage Audio-Frequency Vacuum Tube Amplifiers Perfected and Used in the French Army Signal Corps. This Set Has Proven Extremely Efficient and Is Far Smaller in Size and Less in Weight Than the Large Set Shown in Fig. 3, and Is Used Aboard Ships As Well As in Commercial Stations. The Switch at the Left Permits of Using the First Bulb As a Detector When Desired. These Photos Show the Front View As Well As the Interior View of the Set.

of the three tubes. The switch allowing the use of the first tube as a detector is mounted on the front panel, while the cabinet contains only the three audio-frequency transformers and the grid condenser.

The writer has designed and built for a portable set, an amplifier embodying the same characteristics as the model just described but much smaller in size which is represented in Fig. 7. This is to give an idea of what can be done in this line when an apparatus is properly designed to meet a special requirement.

A great number of radio-frequency *amplifiers* have also been built, and at the present time these apparatus make possible the reception of radio signals with very small indoor aerials, including loop or coil aerials no longer than a cigar box. But as this line of apparatus is quite different, it will be described in a future article.

Miscellaneous

The American amateur radio man often experiments with other circuits than those here shown, for example: Method of using one or two audion bulbs to amplify the signals rectified by a crystal detector. Where expense is an item or for other reasons, this system can be used, but the most reliable, all - around outfit, of course, is that employing a vacuum bulb as a detector, in addition to the one or more bulbs employed as amplifiers. There are several vacuum tubes on the American market available to amateurs which operate on as low a plate potential as 20 to 22 volts, the voltage rating of the usual "B" block battery now on the market. There are many wrinkles which will help to improve the operation of audion amplifier sets, particularly when two or more steps of amplification are utilized, and which often cause supersensitive electrical conditions about the various instruments, particularly the bulbs themselves. One of the leading American manufacturers has found it advisable to enclose the audion coupling transformers in a metal case and the experimenter can try out different stunts such as this, so as to eliminate the freak conditions which sometimes bother one considerably in endeavoring to amplify thru several stages. One American radio manufacturer encloses the coupling transformer in a brass shell, while in a German set which was examined the audion transformers were enclosed in sheet steel shells. One of the mistakes amateurs make is supposing that the apparatus can be operated at high efficiency by simply mounting the various audion receptacles, switches, etc., on a wooden panel, but this is not so at all, and for best results the switches and other metal current carrying members really must be mounted on either fiber, hard rubber or Bakelite. If wood must be used, it should be thoroly soaked in hot paraffin or beeswax, or a mixture of the two.

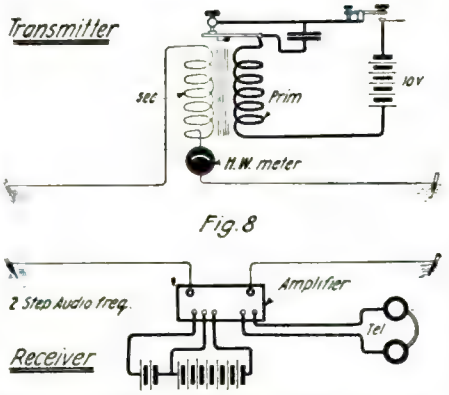


Fig. 8

Fig. 8. Hookup and Arrangement of Buzzer Transmitter, Together with Two Step Audio-Frequency V. T. Amplifier Used in Carrying on Telegraphic Communication in the Front Line Trenches of the French Army, During the War. This Set Worked Over Surprisingly Long Distances Considering the Small Wattage Used in the Buzzer Transmitter, and by Changing the Code Used Every Day or So, There Was Little Chance of the Enemy Interpreting the Words Sent by This Method. This System Is Known As the T. P. S. System, Which Is the French Abbreviation for Telegraphie Par Sol, Meaning "Telegraphy Thru the Earth."

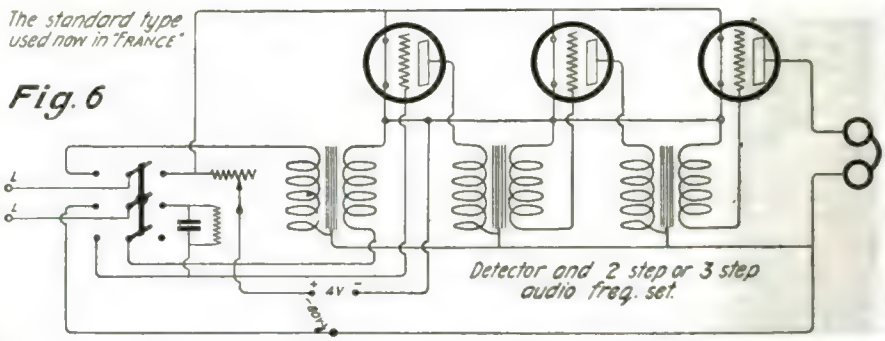


Fig. 6. Connections of Three Bulb Standard Audio-Frequency Amplifier Used Latterly by the French Army Signal Corps and Providing for Quick Change from Detector and Two Step Amplifier to Three-Stage A. F. Amplifier.

U. S. Bureau of Standards News

Observations of Radio Transmission Phenomena by Amateur Radio Operators.

It has been observed by radio amateurs generally that the strength of signals received from a given transmitting station varies rapidly during very short intervals of time, probably depending upon the weather and various meteorological conditions. The Bureau of Standards has desired to collect as much data as possible on the nature and causes of this fading of radio signals. In order to secure simultaneous observations of signals, arrangements have been made for a number of well-equipt amateur radio stations, including 6 transmitting stations and about 40 receiving stations, to begin such a series of tests. The 6 transmitting stations will send out a broadcast message, each of which will last about 3 minutes, on Tuesday, Thursday, and Saturday evenings, beginning just after the time signals from the Arlington Naval Radio Station. The 6 above-mentioned stations will transmit for their different regions 10 minutes apart and 3 or 4 of them will be within the receiving range of each receiving station.

The Bureau of Standards has supplied forms on which the operators will record the strength of the signals they receive and other information, such as weather conditions, presence of strays or atmospheric disturbances, and the general character of radio transmission at the time of each observation. It is hoped that as a result of this program of careful observations some valuable conclusions regarding radio transmission will be reached. If the present plan, which covers only the northeastern part of the United States, is successful, a more extensive program may be undertaken at a later date.

Lecture Explaining the Phenomena of Radio Telegraphy and Telephony

Communication by means of electricity without wires has progressed very rapidly during the last few years, and has probably been given more consideration by the general public than almost any other scientific subject. It is, nevertheless, a fact that due to the somewhat inaccurate and misleading newspaper accounts which have appeared from time to time dealing with

(*Continued on page* 1348.)

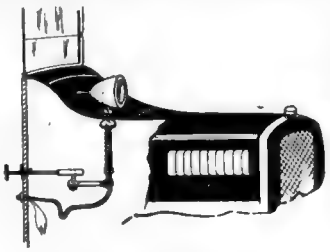
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LATEST PATENTS

Spot-Light Mounting.

(No. 1,363,426. Issued to Charles Mee.)

This invention relates to a method of mounting spot-lights on the automobile engine hood, so that the spot-light

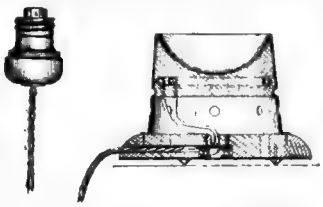


may be operated by the driver of the car thru the agency of rods. When it is desired to tilt the lamp down, the operator draws the rod and handle toward him. When he wishes to tilt the lamp up he pushes the handle away from him. When he wishes to turn the lamp from side to side he moves the handle to the right or left, swinging the rod on the dash board as a center and this in turn swings the arm and turns the stem of the lamp and the lamp as well.

Evaporizer.

(No. 1,359,000. Issued to Carl. L. Stottmeister.)

This invention has for its main object to provide an evaporizer, in which various substances in liquid, powder or solid form are subjected directly to the effects of heat within an integral of the heating apparatus. It is portable and has a relatively cool base when in

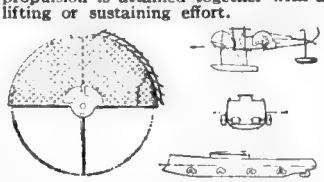


operation and there is a cup-like metallic receptacle in its upper part, so that when current is turned on, certain resistance wires are heated and evaporize the medicant. This is particularly adaptable for treating such diseases of the respiratory organs and such affections as sore throat, hay-fever, catarrh and asthma.

Propulsion Means.

(No. 1,360,182. Issued to Salustio Valdés Cortés.)

This is indeed a very clever method of arrangement for a paddle wheel or rotating propulsion mechanism, mounted on a vertical, horizontal or inclined shaft, whereby the inventor realizes some possibilities, which were heretofore overlooked. He adapts the invention for airplane, submarine or seagoing vessels with but slight modification. Essentially it consists of a new casing made to fit over one-half or more of the paddle wheel, which casing is constructed with permeable or perforated lateral sides, and with holes or openings and deflecting vanes in its perifery whereby greater efficiency of propulsion is attained together with a lifting or sustaining effort.

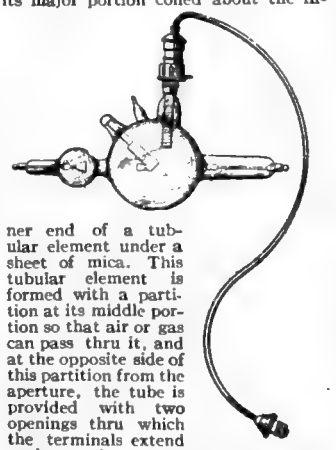


This box or casing which is fitted around the propeller utilizes the centrifugal force of the revolving medium, air or water, confined in the casing by converting it into propulsive or lifting effort.

X-Ray Tube

(No. 1,359,300. Issued to Edmund Wandner.)

This invention aims to provide for an improved X-ray device including a manually controlled regulator by means of which a very steady or uniform vacuum can be maintained in the X-ray tube, and by means of which the vacuum can be lowered so as to prevent the tube from being punctured. It also affords an easy method of controlling the current. It will be seen by referring to the diagram that a screw-plug is formed so as to be adapted to fit an ordinary electric lamp socket, which likewise fits a regulator or rheostat-socket, whereby the resistance and current strength may be regulated. A wire of relatively high resistance has its major portion coiled about the in-

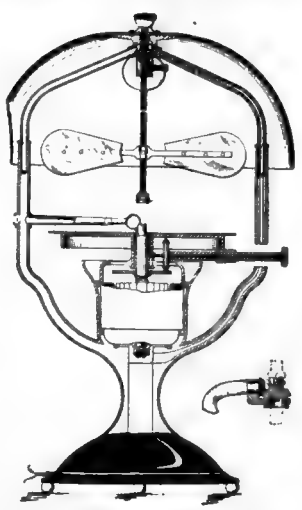


ner end of a tubular element under a sheet of mica. This tubular element is formed with a partition at its middle portion so that air or gas can pass thru it, and at the opposite side of this partition from the aperture, the tube is provided with two openings thru which the terminals extend to the exterior and thence connect to the current line.

Combined Light, Fan and Phonograph.

(No. 1,359,053. Issued to Peter R. Gonsky.)

This rather simple, yet clever device, comprises a phonograph, fan and a table lamp, all within the same con-

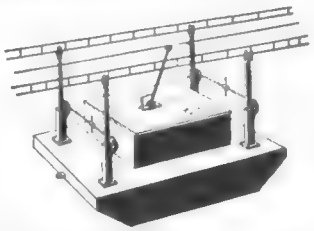


struction. An important feature is that the shaft for the rotating table of the phonograph also rotates or drives the fan and there is an additional interposed flexible shaft connection employed so that a record can be changed without interfering with the driving of the fan. The lamp-motor base is further used as a sound amplifier. The entire device is made in compact form and has a very pretty effect when placed upon the table. A bevel gear is provided so that the device can be used to drive small household appliances such as massage vibrators, which gears may be thrown into or out of operating position.

Electrically-Propelled Boat.

(No. 1,355,156. Issued to Maria Rodrigues Loija.)

Altho this invention will require considerable expenditure in order to make it operate properly, when once

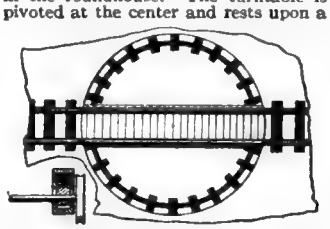


installed, it promises to be very successful, in that not alone is a ship propelled by electric current operating a motor, but it requires no steering control. There are two horizontal members which engage four wheels serving to guide the vessel over the waterway. These wheels are on standards automatically or manually adjustable for changes in tide and current, which also serve to act as one conductor, whereby the power will be conducted from any suitable source to the motor on the boat.

Turntable.

(No. 1,355,722. Issued to Byron E. Viele.)

The invention relates to an improved method of operating a turntable in roundhouses, etcetera, so as to dispatch locomotives to different points in the roundhouse. The turntable is pivoted at the center and rests upon a

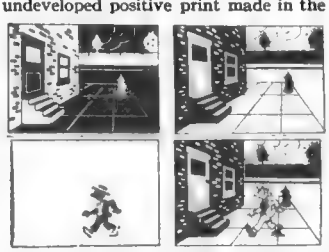


circular track. An electric motor or steam engine is housed at the center point, and thru the agency of bevel gears, power is transmitted to friction wheels which serve to drive the table around on the circular track.

Animated Cartoons.

(No. 1,355,648. Issued to Leslie Elton Brownley.)

This invention provides for an improvement in making animated comic characters or cartoons and photographic backgrounds, or so-called "real life action" upon motion picture films, or also in making real life action in combination with animated silhouette figures. The inventor first takes a photograph of real life action and produces a positive print therefrom, but does not develop this positive print. Then he makes a cartoon character in detail upon a black background by projecting the negative of the real life image on to a ground glass and sketching the character therefrom. Now a black silhouette of the cartoon is made, omitting all detail; a print of this silhouette is also made, when this latter negative print is placed upon the undeveloped positive print made in the

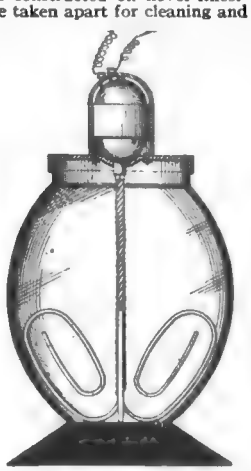


second stage, and both are subjected to light. Upon viewing the same in its developed state we will find a real life background with a black silhouette figure. The cartoon that has been drawn is then photographed and superimposed in the position occupied by the black silhouette figure, giving us a cartoon figure acting with real life objects on real life backgrounds.

Electrically-Operated Egg-Beater.

(No. 1,359,208. Issued to Burr D. Viers.)

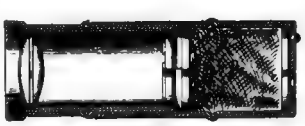
This little device is so arranged that it is readily adapted for disposition on the top of an ordinary glass or tumbler and is constructed on novel lines. It can be taken apart for cleaning and re-



pairing. There is a dome-shaped casing covering the motor and openings are formed in the sides of the casing to facilitate the introduction of oil. It will thus be seen that when the cover is removed from the receptacle, the motor will also be removed, while the dasher shaft will remain in the receptacle. Thus the dasher can be changed or cleaned without taking the motor apart or removing the motor from the cover.

Photographers' Light-Meter.

(No. 1,361,999. Issued to Charles Clinton Howenstine.)



This meter is intended for determining the strength of light, particularly in taking photographs so as to give the correct exposure for any diafram opening and any speed of exposure of plate or film. Enclosed within the meter is a self-luminous body or compound which constitutes the standard. A light coming from the subject is compared with this self-luminous body and by adjusting the shutter so as to cut out or allow for a greater proportion of incident light, a point is reached where both lights will match exactly, by means of a suitable scale, the correct exposure for any stop or speed of film or plate, etc., is easily determined without calculation. Before the light enters from the subject it passes thru the uncovered portion of the shutter opening, then thru a diffusing body and a color screen. This color screen may be a gelatin film, stained a bluish-green color and therefore only transmits light of the same color.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

What To Invent

By JAY G. HOBSON

PRACTICALLY all modern player pianos have automatic tracking devices for the purpose of keeping the music rolls in proper alignment with the holes in the tracker-bar, which represents the eighty-eight keys, the number on all standard pianos.

For Years Railroad Travelers, Especially Those Having to Make Journeys Between Cities Early in the Morning, Have Had to Go Without Anything to Eat Until the Dining Car Was Ready to Serve Breakfast. What a Boon It Would Be to Travelers If Some Progressive Railroad Manager Would See Fit to Have Developed and Installed, a Suitable Coin-in-the-Slot Sandwich Machine As Well As a Coffee Dispensing Device.

If the perforation in the paper music roll does not pass over the hole in the tracker-bar there can be no playing of music. The reason for this fact is, that player pianos are in reality another form of the vacuum cleaner, adopted to make the piano play. Therefore if the note hole in the music roll fails to effect a proper conjunction with the hole in the tracker-bar, the piano keys cannot operate because of insufficient vacuum and air pressure—hence no music.

There are several semi-successful tracking devices for player pianos on the market, but all have their faults, causing no little dissatisfaction and trouble in operation, by tearing the paper music rolls or causing discords in playing when the rolls are not tracking properly as required for good music.

In view of the present unsatisfactory tracking devices installed on player pianos, and because of the great need for a practical and simple improvement upon same, there now exists a splendid opportunity for the inventive public to exercise their ability of creation by perfecting a new design for this important purpose.

I would suggest that the reader procure catalogues of the different player mechanisms, which will explain the player action and automatic tracking device in detail. The present tracker construction is made to operate from the vacuum or suction that also produces the music in the player piano. But, the pneumatic tracker soon becomes clogged with dust and lint from the paper roll, thereby making it ineffective in keeping the roll properly aligned.

In my opinion, what is needed is a mechanical tracking device of simple construction, so arranged that it can be quickly attached by the average piano tuner, and made to operate from the mechanism that runs the music roll. If the problem is worked out along this line and solved, I am confident the invention will sell promptly to some large piano company who will gladly pay a good sum or royalty for the improvement.

SANITARY FOOT WARMERS.

The other day I had an occasion to get myself shod in one of these up-to-date, "While-U-Wait" electric shoe repair joints, (And truly—many are only joints, being so small, and built in to make a patron feel out of joint to find a place to wait) where the head man grunts out his gruff interrogation of what is wanted; and when you tell him you are all run down at the heel—needing a new pair, he pushes you, (figuratively speaking) into one of his lame chairs with a remark:—"Put on theese hare slippers," or: "Jus use theese hare paper t'put yourn feet on!"

Dejectedly you slip on an old, dirty pair of carpet slippers about ten sizes too large for you; or else choose the other alternative of assuming an unconcerned air about sitting in your sock feet, secretly thinking everyone around you is looking at your big feet. But the horror of it all is the inner fear you contain, lest in your walking one of your suffocating toes has bitten a hole in your sock which now shows up like an automobile headlight during an eclipse.

Its pesky hard to maintain one's equipoise of appearance when finally you gather enough nerve to let your eyes fall floorward, and to your painful surprise find your fears exactly realized, making you wish your father had been of a darker hue.

But granting that all the above did not happen to you, the need still remains for improved and sanitary foot warmers. While I was waiting for my "heels" the idea came to me picturing individual paper slippers of average size, printed on either side with the advertisement of the repair shop, etc., paper slippers that would certainly be comfortable and warm, as well as, splendid advertising for each shop, because their customers could take them home; they would serve in the place of the frequently misplaced, regular slippers.

An Idea Which Has Often Appealed to the Author, Takes the Form of a Paper Slipper Carrying the Advertisement of a Shoe Repair Shop Like That Shown Above. This Paper Slipper Could Be Given to Each Customer After His Shoes Had Been Repaired, and He Can Use Them at Home for Some Time;—Thus Providing Excellent and Cheap Advertising.

A Simple Water-Purifying Filter, Modeled Somewhat After the Arrangement Here Illustrated, Should Prove Valuable As a Part of Equipment for Life-Boats and in Fact All Vessels Which Make Trips Out to Sea—the Filter After Proper Chemical Treatment of the Salt Water Giving Pure Drinking Water.

SANDWICH SLOT MACHINE.

As I write these jiggles while slowly creeping on the S. & U. R. R. thru the "Tar Heel" state, my liver is having a heated argument with my stomach about the fuel supply. You see these family arguments happen with the best regulated livers and stomachs, when the question of "eats" is a point to be considered.

Whoever figures up the train schedules certainly has some enemy traveling, and takes this early means of revenge by setting the time of departure in the wee-sma-hours, when the first cock crows—or to be more exact somewhere around five A. M. Now, I am sure you will agree that no decent person likes to catch a train before the Sun gets out of bed; for when he does, it surely means an empty stomach and angry liver until the destination is reached.

Of course, if the "Slow & Uncomfortable R. R." provided us early birds with some movable means of obtaining coffee and rolls, even tho it be of the tin can variety, we could hold out and appear a little more peaceful when reaching our destination. However, and sad as it may be, such is not the case. NO, in this case the early bird doesn't get the worm. He gets the grouch instead. So as I sit here on the S. & U. R. R. this hungry morning, weaving our empty way among the fat and juicy morsels that we know these country folks are now enjoying, my mouth begins to water for some good old fashioned ham and—with flapjacks for the finish.

(*Continued on page* 1342)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Scientific Humor

Like an Echo!—"Pa, why do they have repeating rifles?"

"I guess, son, to make every shot tell."

—William Tuman.

Couldn't "Bear" It.—Pulley: "Why did you get so hot-headed yesterday?"

Motor: "The oil ran out of my bearing."—*E. W. Vahle.*

The Origin of Brainstorms.—College Prof: "What is mind?"

Student: "No matter, sir."

College Prof.: "What is matter?"

Student: "Never mind, sir."

H. C. Bearden.

Heard in the Criminal Court.—House: "I've been framed by a bunch of low wood-butchers."

Street: "That's nothing; these crooked car-tracks have double-crossed me."

—F. J. Schwab.

A Hint for Bores.—"Am I boring you?" said the auger to the plank.

"You are boring me to death," groaned the plank.

"I'm sorry," said the auger. "I'll soon be thru."—*F. J. Schwab.*

Depends What He Hits.—"Just think of it, Pat," said the auto salesman to his prospective purchaser, "this car will go sixty miles an hour."

"Foine!" said the Irishman. "And, now, how fast will it stop?"

—Dick Dickinson.

Eggsactly.—Tompkins: "Bently has received a million dollars for his patent egg-dating machine. It's absolutely interference proof, and dates correctly and indelibly as the egg is being laid."

Dewley: "Is the machine on the market yet?"

Tompkins: "Oh, my no! and it won't be either. The patent was bought by the Cold Storage Trust!"—*H. S. Johnson.*

+ And − Is O.—Student of Electricity: "Can anything be both positive and negative at the same time?"

Electrician: "Sure. When I proposed to my girl last night she gave me a negative answer which was very positive."

—Walter Luire McDonald.

A Black and White Artist.—"Well Rastus, I hear you are working again. What business are you engaged in now?"

"I'se done be in de mining business, sah."

"What kind of mining are you doing: gold, silver or diamond?"

"I'se doing calsomining, sah."

—Henry Sorenson.

But the Juice Ain't "Lower" There.—First Student of Electricity: "Why are the lights in lower New York brighter than those in the upper section?"

Second Student: "Because they are nearer the Battery, I guess."

—No Name.

FIRST PRIZE $3.00

Or Feeding "Hootch" to the Radiator!—Teacher: (in physiology class) "Who can tell me what is auto-intoxication?"

A pause—then little Johnny volunteers.

Teacher: "Yes, what is it, Johnny?"

Johnny: "Riding around in an auto till you're dizzy."—*Paul Abramson.*

Little Songs of Safety First.—

Lies slumbering here
One William Lake;
He heard the bell
But had no brake.
—Detroit News.

At fifty miles
Drove Ollie Pidd,
He thought he wouldn't
Skid, but did.
—Rome, (N. Y.) Times.

At ninety miles
Drove Edward Shawn;
The motor stopt.
But Ed kept on.
Little Falls, (N. Y.) Times.

We receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

This monument's
For Jackson Druck;
His Lizzie was lighter
Than the truck.
—Scrantonian.

Down in the creek
Sleeps Jerry Bass;
The bridge was narrow,
He tried to pass.
—Wilkes-Barre Times-Leader.

In peace here rests,
Poor Jerry Fitch
He put his hand
Upon the switch.

In state here lies
Old Archy Hale,
He put one foot,
On the third rail.

The Stomach Contains Indigestion.—The physiology instructor had asked Johnny to name the parts of the body and the organs contained therein.

Johnny answered, "The body consists of the head which contains the brains, if any, the chest, which contains the heart and lungs and the abdomen which contains the bowels which are A, E, I, O, U, and sometimes Y and W."

—Carl Wm. Timm.

No Wonder the Joke Editor Is Blue.—He: "Why does a black cow give white milk that makes yellow butter?"

She: "For the same reason that a blackberry is red when it is "green."

—Dwight L. Parham.

(We heard always that the white cow gave milk and the brown cow gave coffee.—*Printer's Devil.*)

Wasted Science.—Jim: "I see a certain doctor has cured insanity by pulling out infected teeth."

Jam: "It won't do any good; they'll go crazy again when they see the bill."

—Victor C. Heubner.

Heard in Biology. — Teacher: "Johnny, can you tell me what a tissue is?"

Johnny: "Sure, a tissue is a collection of cells, all of which are similar."

Teacher: "Correct. Now give me an example."

Johnny: "The Penitentiary."

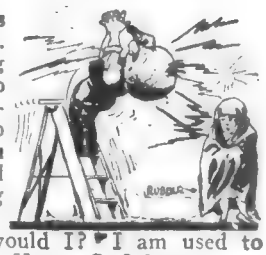
—Chas. E. Harrison.

Scientific Facts.—Sound travels 400 yards per second, but there are some exceptions to the rule.

Scandal—2,000 yards per second.
Flattery—1,500 yards per second.
Truth—2½ yards per second.

—Melvin Greene.

He Was "Charged" Too.—He: (screwing electric fixture to the ceiling) "Better not stand so close Mary, you might be shocked if this thing slips."



Her: "Why would I? I am used to your language."—*Henry S. Johnson.*

Squaring the "Circle."—She: "What shape is a kiss?"

He: "Give me one and we will call it square."—*Albert E. Snyder.*

A Good "Find."—He: "They are a wise couple."

She: "Why?"

He: "They feed their baby garlic so they can find it in the dark."

—Evarest Ryan.

We'll Be Switched.—Trans: "Nellie's hair used to be light, but now it's dark."

Former: "Perhaps she turned off the switch."—*Earl. A. Keiser.*

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

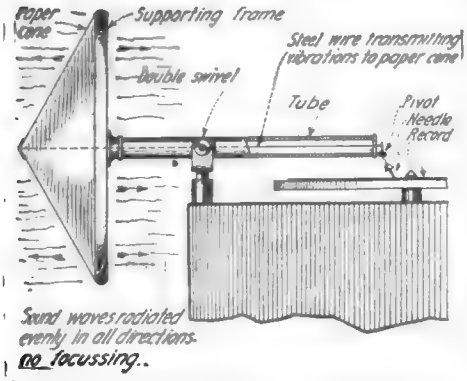
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Hornless Phonograph

(1086) Oscar W. Hartung, Detroit, Mich., asks:

Q. 1. How does the Pathé *Actuelle* phonograph operate?

A. 1. Relative to the two articles "Building Your Own Phonograph" which appeared in the September and October issues of this journal, it would probably be a welcome idea, as you suggest, to publish the details of the Pathé *Actuelle* hornless phonograph, but we have to state that it would hardly be compatible with ethical principles to publish details of a specific machine of this new type.



The Diagram Above Shows the Principal Features of the Hornless Phonograph In Which a Paper Diafram, Taking the Shape of a Cone, Vibrates So As to Radiate Sound Waves In All Directions with Equal Intensity. This Eliminates the Undesirable Focusing Effect of the Usual Phonograph Horn or Sound Chamber.

The details which we did publish were practically all based on common knowledge of phonographs, and we did not feel that we were giving away any great trade secrets in explaining the details there given. The *Actuelle* or hornless phonograph, like all simple things, must be built carefully and very exactly to obtain anything like satisfactory results. The diagram herewith shows its general make-up. The paper cone is a good piece of parchment paper stretched or supported in such a manner as to form a rigid cone, and the center of this cone is attached by a stiff metal wire to the stylus at the inner end of the moving arm supporting the cone.

The secret of the *Actuelle* lies in the fact that the paper cone or diafram vibrates in a particularly free manner, and this causes sound waves to be set up practically all around and thus eliminates the disagreeable focusing effect due to the usual horn—which produces sounds only in one direction, *i. e.*, from inside the horn and outward. Thus it is that with the *Actuelle* a person hears the sound equally well in any part of the room and not in a certain corner of the room as is the case with practically all other machines having a horn-shaped amplifying chamber.

Motor-Bus Versus the Trolley

(1087) H. P. P., L.——, Canada, writes the Oracle:

Q. 1. I am writing you to learn if you can put me in touch with places where I can get information in regard to the comparative cost of operating electric railway and motor-buses. Some business men are of the opinion that the motor-bus cannot compete in a city which has only a population of about 70,000.

A. 1. We would refer you to an article by Mr. L. H. Rosenberg, an engineer of the General Electric Co., which appeared in our May, 1920, issue. In this article are discust some of the merits and demerits of the one-man trolley and their relation to the motor-bus.

To our mind, and providing your city board were faced with the consideration of building a new electric railway, then by all means it would seem the most economical to purchase the necessary number of motor-buses and establish a regular and specific operating schedule, etc. Of course, it is a question not so easily answered, when it comes to the consideration of substituting motor-buses for an already established electric railway.

It would seem to the editor of this column that one of the important factors bearing on this particular matter would be whether or not the electrical energy for operating the present railway is derived from coal or from a hydro-electric system. As you undoubtedly know, the gross efficiency obtainable from small or medium size steam-driven electric power plants is very low, and does not usually rise above 7 to 8 per cent.; while if the electrical energy required is secured from a hydro-electric system, particularly if it is owned by the operating company, this may show a gross efficiency as high as 40 to 50 per cent.

Finally, we would suggest that you write to the American Institute of Electrical Engineers, 29 W. 39th St., New York City, N. Y., and to the American Railway Engineering Institute, 431 Dearborn St., Chicago, Ill., who may have in their files copies of papers presented before these respective bodies that you can procure.

The railless trolley, an omnibus taking power from an overhead wire, has been used more in Europe than in America, and is worthy of careful consideration. There is a very great saving in capitalization, but the passenger-carrying capacity is more limited than in the case of a regular electric railway.

We described and illustrated the railless trolley in our issue of July, 1916, to which we refer you.

Electric Motorcycles

(1088) Fred Post, Auburn, Ill., asks the Oracle:

Q. 1. In the article by Mr. Secor in the January issue, on building a small automobile, it is stated that the electric type requires 300 to 600 amperes. At this rate and figuring on 15 amperes per battery, 25 starting type batteries would be required weighing 1,500 pounds, and costing about $750. Is this right?

A. 1. Concerning the number of storage batteries required for operating the small automobile as outlined in the article in the January number of SCIENCE AND INVENTION, would say that the figures you give are right, but in actual practice those who have built electric motorcycles have done either of two things, it seems:

1. They operate the batteries at a higher discharge rate and use a smaller number of them than that theoretically required, or:

2. They do not operate the motor with the full load current required, or in other words, the motor is operated at a lower horse-power output.

There is a photograph and description of an electric storage battery motorcycle in the February number.

Water Motor Query

(1089) Roy E. Dukette, Hoboken, N. J., asks:

Q. 1. Several queries about water motors.

A. 1. Small water motors can be procured from several manufacturers of these devices.

With a ¼-inch pipe and 25 pounds pressure, we do not believe that you can develop much over 1/6 to 1/5 horse-power, altho if you can procure a very efficient turbine, you might develop as much as ¼ horse-power.

Operating 32 Volt Lamps on 110 Volt A. C.

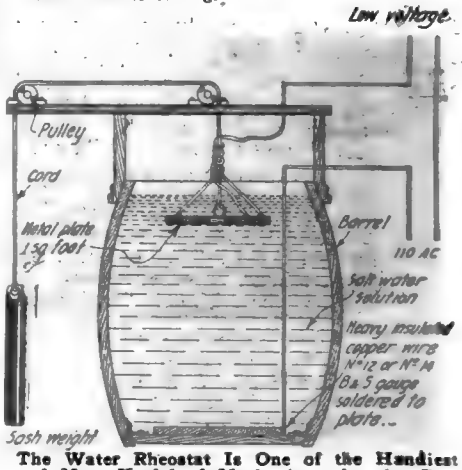
(1090) R. M. Ayers, Detroit, Mich., writes:

Q. 1. What is the simplest way to operate 32 volt lamps from 110 volt A. C. mains?

A. 1. In reply to your query asking for the easiest way to reduce 110 volts A. C. to 32 volts, for operating lamps rated at this potential, we would advise as follows:

The usual method of doing this and the one in commercial use for operating the lamps at 32 volts from a 110 volt circuit is by means of a step-down transformer. Four lamps might also be burned in series on 110 volts.

You did not state in your letter how many watts you will need. But as you mentioned therein that your particular requirements are of an experimental nature, we would suggest that you reduce the voltage in the same way as that followed in shop and field work, by means of a water rheostat. A diagram is given below showing a water rheostat made from a small wooden barrel or keg.



The Water Rheostat Is One of the Handiest and Most Useful of Mechanisms for the Purpose of Controlling the Amount of Current Supplied to Any Certain Piece of Electrical Apparatus. A Very Serviceable One May be Made from a Barrel, the Larger the Barrel the Greater the Current Capacity, and Vice Versa.

Of course the rheostat will have to be proportional in size to the amount of energy or watts you require. With a saturated salt water solution in a beer keg and using iron or other plates in the solution having about one square foot area each, you can take care of 500 to 600 watts, and somewhat more than this for shorter periods.

How Many Miles of Wollaston Wire per Cu. In. Platinum

(1091) William A. Romans, Baltimore, Md., asks:

Q. 1. Several questions as to the ductility of platinum wire.

A. 1. Regarding the ductility of platinum, we have calculated the length to which this wire can be drawn.

The very common form of Wollaston wire is that used in ordinary delicate electrical instruments which has a thickness of .0004 inch. The cross-sectional area of this wire is .000,000,125,664 sq. in. by the formula, area is equal to $\frac{\pi d^2}{4}$ dividing this into 1 square inch we obtain the figure 7,957,730. In other words, there will be exactly 7,957,730 inches of wire in 1 cubic inch of platinum.

This will give us 663,144 feet or 125.6 miles of wire obtainable from 1 cubic inch of platinum. Inasmuch as 1 cubic inch of platinum weighs .7758 pounds, we obtain a figure of 162 miles for one pound of wire. This wire is however, not the finest platinum wire obtainable. We have on record, wire w[illegible] diameter is .00004 inch. This will mea[illegible] a wire of the above thickness could [illegible]wn out just 100 times as long as the [illegible] mentioned wire or 16,200 miles.

This light wire is [illegible] means the smallest wire obtainable; it [illegible] mercial product and can be obtained [illegible] market.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

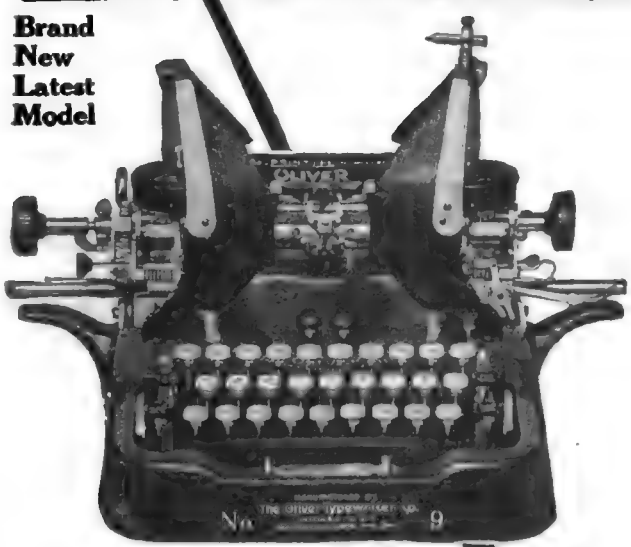
Was $100 — Before the War — Now $64

SAVE $36

Buy Direct From The Factory

Try the Oliver for Five Days at Our Expense

Brand New Latest Model



A Finer Typewriter at a Fair Price

Only $4.00 Per Month

Do not buy or rent any typewriter until you know the Oliver. A five days' trial will help you decide. Besides saving you $36, we make the payments easy. We ask no advance payment. But merely $4 per month until the $64 is paid.

Do not confuse this offer with those for second-hand or rebuilt typewriters. Our $64 Oliver is our brand new identical Model 9, formerly priced at $100. It has not been changed in the slightest.

Over 900,000 Sold

Olivers are in use all over the world. Some of the large concerns in the United States using Olivers are: U. S. Steel Corporation, Nat'l City Bank of N. Y., Diamond Match Company, Pennsylvania Railroad, Hart, Schaffner & Marx, American Bridge Company, Encyclopedia Britannica, Otis Elevator Company, Bethlehem Steel Company, Boston Elevated Railway, N. Y. Edison Company, and a host of others of equal importance.

And thousands of Olivers are used by individuals—every business is represented among our users. And every profession.

You can depend on this wide use of the Oliver as a guarantee of its worth.

No Finer Built

Examine the Oliver carefully. It is built in a model factory with a heritage of ideals. Only the finest materials are used. And this accounts for the prolonged life of the Oliver, its durability, its inbuilt service. It is simplified in construction and built to withstand the hardest usage. The Oliver in war service proved its fine design and construction.

You can't buy a better typewriter at any price.

Mail the coupon now, for either a Free Trial Oliver or further information.

This Simple Plan Makes It Easy to Own an Oliver

This sales plan is a legacy of the war, which taught us all new economies—ones we won't forget.

By reorganizing our method of distribution, we were able to make a radical reduction in price.

We did not change the famous Oliver an iota. The machine we now sell for $64 is the identical one formerly priced at $100—our latest and best model.

During the war we learned that it was unnecessary to have great numbers of traveling salesmen and numerous, expensive branch houses throughout the country. We were also able to discontinue many other superfluous, costly sales methods. You benefit by these savings.

Pre-war extravagances were ended. And our plan of selling made simpler. We send the Oliver to you for free trial, so that you may judge it, in solitude, without being influenced.

Send No Money

Merely send us the coupon. We ship an Oliver to you. Try it for five days. Then if you agree that it is the finest typewriter at any price, merely send us $4 per month, until the $64 is paid.

If you do not believe that this is the greatest typewriter opportunity, return the Oliver to us, express collect. We even refund the outgoing transportation charges. You have not placed yourself under any obligation to buy.

When the Oliver comes to you, you will admire its many advancements—all the refinements made possible during 24 years of typewriter-making. A finer typewriter is impossible. The coupon below gives you the opportunity to be your own salesman and save yourself $36.

Note that it brings EITHER an Oliver for Free Trial, or further information. Check it accordingly.

Canadian Price, $82

The OLIVER Typewriter Company

674 Oliver Typewriter Building, Chicago, Illinois

THE OLIVER TYPEWRITER COMPANY,
674 Oliver Typewriter Building, Chicago, Illinois

☐ Ship me a new Oliver Nine for five days' free inspection. If I keep it, I will pay $64 at the rate of $4 per month. The title to remain in you until fully paid for.

My shipping point is.....

This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name .....

Street Address.....

City..... State.....

Occupation or Business.....

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Auto Owners WANTED!

To introduce the best automobile tires in the world. Made under our new and exclusive Internal Hydraulic Expansion Process that eliminates Blow-Out—Stone-Bruise—Rim Cut and enables us to sell our tires under a

10,000 MILE GUARANTEE

We want an agent in every community to use and introduce these wonderful tires at our astonishingly low prices to all motor car owners.

FREE TIRES for YOUR OWN CAR

to a representative in each community. Write for booklet fully describing this new process and explaining our amazing introductory offer to owner agents.

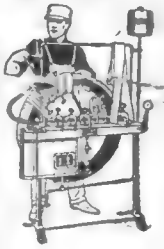
Hydro-United Tire Co.
DEPT. 217 PHILADELPHIA, PA.

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2203 Fourth St. Waupun, Wisconsin

MEN WANTED

Mechanically Inclined —to send for my big illustrated 72-PAGE BOOK— **FREE!**

It tells how in a few weeks you can earn from $150 to $400 a month in the Auto and Tractor business. ***Be Your Own Boss.*** At small cost learn to be an expert mechanic by the Sweeney System of working on real cars. ***Use tools not books.*** Simply send your name and address today, a post card will do, for our Free book and 27 photographic reproductions of machine shop work, etc. **Let's Go---Write Now!**

EMORY J. SWEENEY, President

LEARN A TRADE—Sweeney

SCHOOL OF AUTO-TRACTOR-AVIATION
128 SWEENEY BLDG KANSAS CITY, MO

$100 A WEEK AND MORE FOR YOU!

Chas. Evans, carpenter, of Ind., earned $100 weekly last year. Gibbard of Mich. did $60,000 business in 1920. Others had sensational records. All did it with **Haywood's Tire Surgery.** Twelve years ago I began with $1000 and new tire repair idea. Now own $400,000 business. I've started hundreds of men from all walks of life — without experience — with very little capital—on same road to financial success. Let me start YOU. Write today. M. Haywood, Pres.

HAYWOOD TIRE & EQUIPMENT CO.
1209 Capitol Avenue Indianapolis, Indiana

How Big Are Molecules?

By ROGERS D. RUSK, M.A.

(Continued from page 1286)

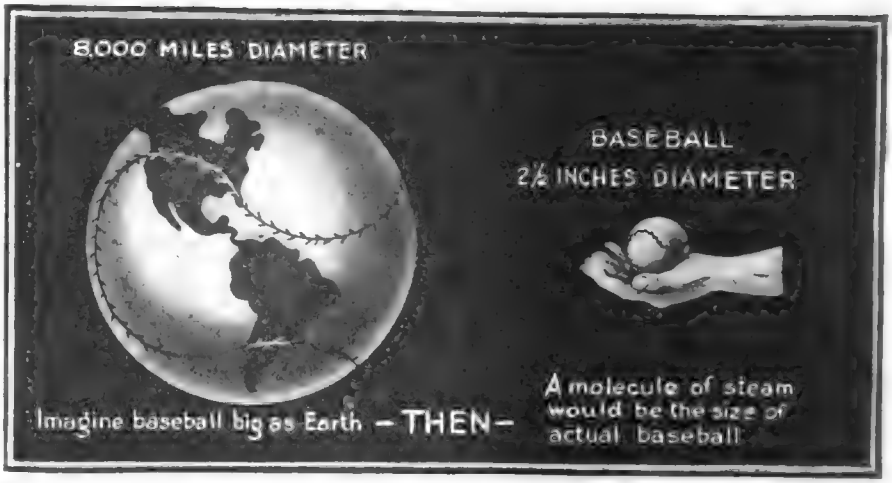

8,000 MILES DIAMETER
BASEBALL
2½ INCHES DIAMETER
Imagine baseball big as Earth — THEN —
A molecule of steam would be the size of actual baseball

Fig. 4. The Illustration Above Shows That if a Baseball and a Molecule of Steam Were Magnified Until the Baseball Was as Large as the Earth, Then the Molecule of Steam Would Be About as Large as the Baseball Was. Fig. 1 Below Shows Comparative Size of Atoms.

Prof. Millikan, the American investigator, in his wonderful laboratory at the University of Chicago, has carefully measured and determined the electrical charge of the electron under very elaborate laboratory conditions.

An article describing how the electron was measured and even weighed, appeared some time ago in this journal, and those interested in the electron theory and the precise mathematical measurements of this basic quantity of matter, according to the present-day hypothesis, will find Prof. Millikan's book entitled "The Electron" extremely interesting and valuable.

The illustration at Fig. 5, brings out in a clear manner, the extremely small mass of the electron of which the human body and all other matter is now supposedly constructed. Imagine a powerful ray of light focust on to a spot on the man's chest down to a point no larger than the head of a pin, and that in turn, the reflected light ray is magnified or enlarged to the size of the earth, or a circle 8,000 miles in diameter. The whirling electrons would only then be visible as shown to the left of the illustration, Fig. 5. The continents of North and South America are superimposed on the illustration at the left of Fig. 5, to emphasize the idea that this enlarged view of the area the size of a pin-head, on the man's body, is of the same size as the earth or 8,000 miles in diameter.

Blasting Pole Holes

By E. H. Dana, Missouri.

I had an opportunity, late last fall, to try a new method of digging pole holes for the Cairo Light & Power Co., of Cairo, Mo.

There were 155 holes needed, 20 in hard rock, the balance in clay soil. The holes were wanted in a hurry and labor was scarce. I have seen the use of dynamite advocated for this purpose and had read a description of the proper way to do it.

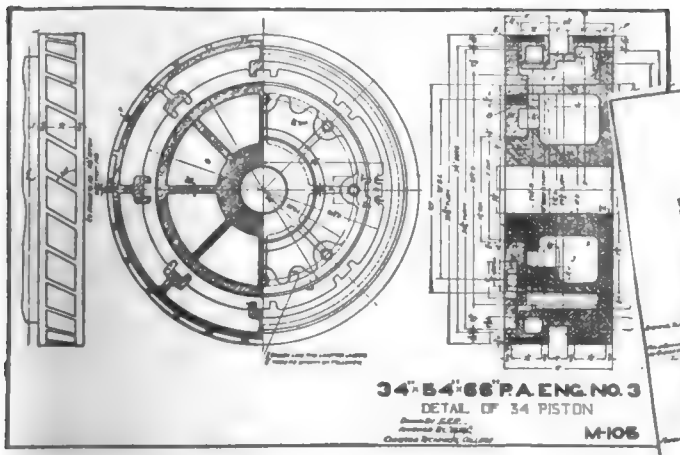
Bore holes were put down to a depth of five feet. Two cartridges of 40% dynamite were cut in halves. The four half sticks were tied to a thin strip of wood spaced about six inches apart. A cap and fuse were inserted in the top piece of dynamite. The holes were not tampt, as we desired a hole of only large enough diameter to take the pole. The less the surrounding soil was disturbed and broken up, the better.

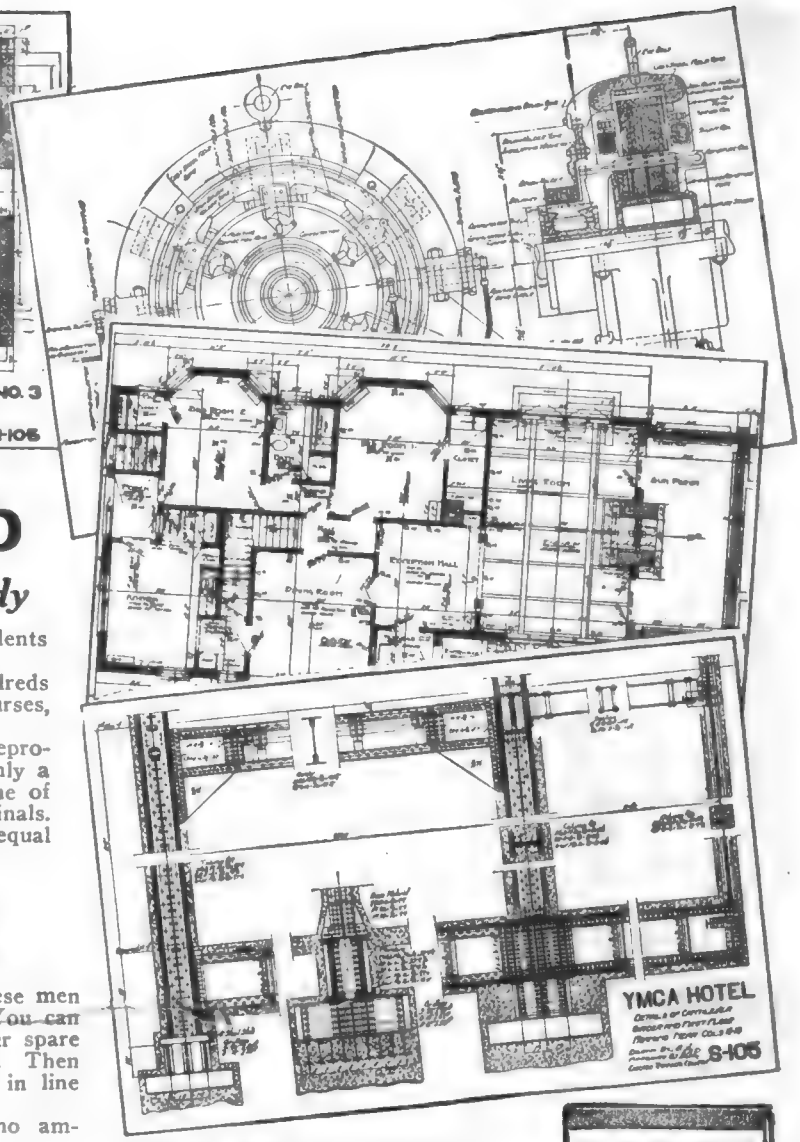
The shots made a clean, well shaped hole, just right for planting a pole.

The work consumed thirty hours' time. The total cost for labor and explosives was $80, or a trifle over 50 cents per hole. The engineer in charge was entirely satisfied with this cost.

Of course, the method described applies only to the holes in clay. The holes in the rock were blasted in a way well understood by engineers, so will not be described here. However, the rock work added materially to the labor cost of the job. Had all the holes been in earth the expense would have been somewhat less.

Digitized by Google Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN





Draftsmanship

Become an Expert by Home Study

The illustrations show the work of some of the students of Chicago Technical College.

These drawings were picked at random from hundreds equally good made by men who, before taking the courses, had had no training as draftsmen.

Naturally the large reduction made necessary to reproduce the drawings in the space of this page gives only a partial idea of the high excellence of the work—some of the lines losing the strength they show in the originals. But even so, it will be seen that these drawings are equal in merit to the work of men of long experience.

Make Yourself Worth $60 to $150 a Week

You, too, can master draftsmanship as easily as these men did under the Chicago "Tech" method of training. You can soon become proficient simply by giving some of your spare time to home study under the direction of our experts. Then you will be ready to step into a paying job and be in line for promotion to important managing positions.

Draftsmanship today offers opportunities which no ambitious man should overlook. American industries are constantly looking for experts—and none are more eagerly sought than the draftsman.

No need for you to settle down in any humdrum occupation or to accept an outlook without promise of large success when great manufacturing organizations, railroads, architects—all classes of concerns engaged in technical work—are searching everywhere for trained men. At least look into this profession today.

Train Under Practical Men

From the day you enroll with Chicago "Tech" you are under the direction of practical engineers who teach you thoroughly the methods which they use in their own work and which you will use when you practice the profession yourself. Lessons, exercises and special texts deal with conditions as they exist, so when you graduate you are perfectly familiar with the actual work of the drafting room.

You are carefully instructed on every point, taken upward step by step, everything being made so clear that your advancement is sure and constant. No time is put in on unnecessary studies—you concentrate on the work that will make your services in demand.

You get the same instruction by mail that you would get if you came to Chicago to attend the College. Therefore if now employed you can hold your present position until you are ready to enter the field of expert Draftsmanship.

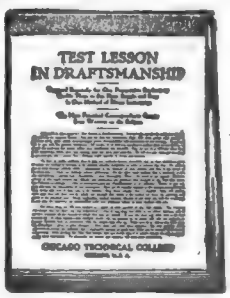
Moderate Fees, Easy Terms

Chicago "Tech" offers this practical instruction at a price and on terms which place any of the courses within the reach even of the man of moderate means. And payment can be made on easy monthly terms. No man who wants such training can give himself an excuse for not grasping the opportunity now.

CHICAGO TECHNICAL COLLEGE
445 Chicago "Tech" Bldg. CHICAGO, ILL.

Digitized by Google Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

FREE TEST LESSON



This free test lesson will show you how well qualified you are for Draftsmanship and how practical the Chicago "Tech" courses are. While other schools ask you to enroll and send money first, we send the free lesson first. The only offer of its kind. Read the lesson, practice the exercises and then decide for yourself whether to take the course or not. No obligation on you for asking for this.

Drawing Outfit—No Extra Charge

FREE outfit is included with our Home Study Course or credit given if you already have an outfit. These are high grade instruments, drawing board, T square, etc.—same as used by leading draftsmen.

Other Chicago "Tech" Courses

Chicago "Tech" opens the field of specialized training not only in Draftsmanship but in other paying lines also. If you want information on any of these, mark the coupon with X to show which subject interests you and full information will come by return mail.

SEND THE COUPON

No obligation upon you is implied when you ask for the facts about Chicago "Tech" instruction. We gladly send catalogs and information telling you about the opportunities offered in any line of work we teach. Then you can decide what the field offers for you. Big jobs are waiting now for men like you—WITH TRAINING. Send the coupon—today.

CHICAGO TECHNICAL COLLEGE, 445 Chicago "Tech" Bldg., Chicago, Ill.

Without obligation on my part, please send free and postpaid, instructions on how I can become an expert in subject marked below:

[ ] Architectural Drafting	[ ] Auto. Engineering
[ ] Machine Drafting	[ ] Aero. Engineering
[ ] Electrical Drafting	[ ] Gas Engines
[ ] Structural Drafting	[ ] Plan Reading—Buildings
[ ] Sheet Metal Drafting	[ ] Estimating—Buildings
[ ] Topographic Drafting	[ ] Plan Reading—Machinery
[ ] Surveying	[ ] Plumbing—Estimating
[ ] Designing	[ ] Heating and Ventilating
[ ] Contracting—Buildings	[ ] Steam Engineering

Name.....

Address.....

Post Office..... State.....

Free Trial Lesson included when inquiry is for Draftsmanship or Plan Reading.

College or Home Study, state which.....

Learn to Draw at Home

Illustrators, Cartoonists, Commercial Artists earn big money. $25 to $100 a week and more. Learn at home in spare time under personal direction of Will H. Chandlee, famous newspaper, magazine, advertising artist of 35 years' successful experience.

BE AN ARTIST

Delightful, fascinating profession. Wonderful new home-study method makes drawing easy! Send coupon or postal today for special offer of complete Artist's Outfit FREE to new students. Write for handsome book "How to Become an Artist." Don't delay—write or send coupon at once. Address

Washington School of Art, Inc.
Room 1612 Marden Bldg., Washington, D. C.

FREE COUPON
Washington School of Art, Inc.
Room 1612 Marden Bldg., Washington, D. C.
Send me particulars of FREE ARTIST'S OUTFIT offer and Free Book, "How to Become an Artist."
Name .....
State whether Mr., Miss or Mrs.)
Address .....
City ..... State .....

Here's a Tool You've Waited For

HAN-D Hammer

Four Tools in One

Send only your name and address—no money—and we will send you this clever handy, practical tool. It's the real tool of a thousand uses and at a price far below what it would ordinarily sell for. No automobile kit should be without it—it should be in every home—every workshop—every garage—every farm—every office. Every part of the tool is fully guaranteed. The three screw-drivers nested in the hammer handle are of high grade tool steel and all parts are nickel-plated and highly polished.

Send No Money

$1.79 and postage ON ARRIVAL

For Garage, Shop, Home and Office

The HAN-D HAMMER is 7½ inches long and weighs but 10 ounces. It is a tool for long and reliable service. We are so sure that you will be more than satisfied with it that we send it to you without one single penny in advance.

Order NOW!

The Handiest, Most Useful Tool Ever Invented

Remember—don't send one penny with your order. Just your name and address on a post card and we will send you this wonderful HAN-D HAMMER. All you need do is pay postman the specially low price of $1.79, and postage, on arrival at your door.

Order Now Don't delay in putting this most useful of all tools to work for you. Send your name and address today. Don't pay one cent until delivered. You take no risk—satisfaction guaranteed or money back.

MOTORIST SHOP
21 W. Jackson Blvd. Dept. 210, Chicago, Ill.

You Can KNOW all about AUTOS, TRACTORS, AEROPLANES, STARTING and LIGHTING SYSTEMS, STORAGE BATTERIES, VULCANIZING, etc.

Valuable Book FREE

"How to Succeed in the Automobile, Tractor and Aeroplane Business," gives much new and very useful information; also tells all about the many splendid advantages and practical training you can get at this college in a few weeks. Tear this out and write for a copy, FREE, today.

GREER COLLEGE OF AUTOMOTIVE ENGINEERING
Dept. 124 1519 S. Wabash Ave.
CHICAGO

Recent Work of the Bureau of Standards

(*Continued from page* 1305)

avoid absorption of gases and in special refractories. The latter treatment guards against solution by the molten iron of small amounts of impurities which occur when the former comes in contact with any ordinary refractory materials. With vacuum fused electrolytic iron as a starting point alloys have been prepared containing the elements commonly present in steel. Mechanical, thermal, microscopic and magnetic tests on these alloys reflect the relation between these properties of steels and its chemical composition.

NEW TEMPERATURE CHANGE THEORY OF CRYSTALLINE QUARTZ.

Strange enough, it would seem, that the Sugar Section of the United States Bureau of Standards, engaged as it is in the study of sugars, both common and rare, should stumble upon a new theory relating to the properties of quartz. The latter, however, is employed extensively in the construction of polarimeters, a device common to the sugar industry, and while analyzing the natural rotation of light by crystalline quartz the research led to other fields of science.

At a temperature of 573 degrees Centigrade crystalline quartz changes into another crystal, with a transformation of energy during the process. Here a scientist of the government, by employing special equipment consisting of a large electromagnet for studying the effect of magnetism upon light evolved the theory that the temperature at which the transformation starts when the crystal is being heated is sharply defined; namely, that of 573°.3 C. The change of energy at this temperature seems to be more clearly marked and more easily determined than that utilized in revealing the ordinary points on the high-temperature scale. A thermocouple close to but not in actual contact with the specimen of quartz will register this point with fine precision. Preferably, the thermocouple should be inserted in a small opening in the crystal, which method standardizes it at a fixed and accurately known temperature.

A study of quartz assembled from widely distributed areas of the United States reveals cumulative evidence that this phenomenon is characteristic of all crystalline quartz. According to the Bureau of Standards, the temperature of 573°.3 C. is a fortunate one inasmuch as there has been heretofore no known method of conveniently calibrating temperature-measuring devices in this region. As the temperature of a crystal of quartz approaches 573° Centigrade a change is exerted in all the physical properties of the substance. The change is particularly abrupt in the optical properties. When light, vibrating in a single plane, penetrates the specimen, the rotation of the plane of vibration which usually occurs in quartz is found to suffer a jarring change as the temperature of 573° is neared. The magnitude of the transformation is, of course, influenced by the wave length or color of light employed. The measurements of polarimeters, as negotiated by the Bureau of Standards, is said to be the first precision determinations made at high temperatures.

(*Continued on page* 1328)

Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page* 1295)

of photography as many novas have been discovered in the past thirty years as have been recorded through all the centuries that elapsed up to that time. A nova a year is about the rate at which they are now being discovered, and how brief a period is a year in the life of a stellar system!

Instead of suns and solar systems evolved from nebulae we are now more familiar with the idea of nebulae evolved from stars through some terrific cataclysm.

It is now known that there exists in certain parts of space a number of sharply-defined stars surrounded by extensive nebulous envelopes. Are these suns that are going thru the process of forming their planetary systems?

The fact is now recognized that pressure of light and electrical repulsion are forces to be reckoned with in the evolution of stars and nebulae as well as gravitational contraction. It has long been felt that the peculiar formations existing among the extended gaseous nebulae could not be explained as gravitational effects alone.

Light-pressure and *electrical repulsion*, as well as *gravitation* are at work within the solar system and the sun is the seat of powerful disturbances which produce periodic outbursts of exceptional activity and which may have produced in the distant past more startling effects than any with which we are familiar at present.

The earth and moon form a system that is in a way unique. No satellite in the solar system is so large in proportion to its primary as is our own moon. Seen from the distance of Venus or Mars, the two bodies would apparently form a *double star*. The diameter of the moon is one-fourth that of the earth. Satellite III of Jupiter far exceeds our own moon in actual size but its diameter is only about four-hundredths of the diameter of the planet its orbit encircles. The diameter of Titan the largest satellite of the Saturnian system, bears the same ratio to the diameter of Saturn. Moreover, all the nearer satellites of Jupiter and Saturn lie nearly in the equatorial planes of these planets, but the orbit of the moon is inclined at a high angle to the plane of the earth's equator.

It is not difficult to believe that the satellites of Jupiter or Saturn were at some time thrown off from the equatorial belts of their primaries, just as the planets themselves may have been ejected from the equatorial belt of the sun, but we cannot so readily believe that our own satellite was formed from the earth in a similar manner.

The moon's orbit lies nearly in the plane of the *sun's* equator however, and it is conceivable that both earth and moon were *simultaneously ejected* from the equatorial zone of the sun, the two nuclei being so close together that the smaller one remained under the gravitational control of the larger

The difficulties in the way of believing that the moon once formed a part of the earth are very great. It has been shown mathematically that if the two bodies at one time formed a single mass it would have been impossible for the moon to break away from the earth, unless the force that caused the separation were sufficient to hurl the moon to a greater distance than two and a half times the earth's radius. Roche found out by computation that a satellite could not remain intact within this distance (2.44 radii, to be exact) of its primary, but could be broken up into small fragments

(*Continued on page* 1356)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

NOTICE TO ELECTRICAL MEN

I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Type Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistances, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information Regarding Wire Used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

The book, called the "Burgess Blue Book," is published and sold by the Burgess Company for one dollar ($1.00) per copy, postpaid. If you wish one of the books, send me your order with a dollar bill, check or money order. I know the value of the book and can guarantee its satisfaction to you by returning your money if you decide not to keep it after having had it for five days.

Yorke Burgess, Pres. **THE BURGESS CO.** 750 East 42nd St., Chicago, Illinois

Consulting Electrical Engineering. Power Plants, R. R. Signals, Electric Railroads, Industrial Problems a Specialty. Information furnished on electrical subjects. Inventions perfected.

$90 TO $125 EARNED PER WEEK by Burgess-Trained Men

MY POLICY

My policy is TRUTHFULNESS in advertising and to give an HONEST and RELIABLE SERVICE. I offer NO FREE INDUCEMENTS but I promise to give you INSTRUCTION, HELP and ADVICE, the kind that is helping hundreds of men and boys to succeed.

YORKE BURGESS, Supt.
Burgess Electrical School

Burgess-Trained Men are not only getting $90.00 to $125.00 per week, but they are earning it. We do NOT promise you will do it, because a good bit depends upon you alone, but the opportunity is there and it is up to you to make the best of it. Burgess Service is so planned that it fits the needs of anyone desiring to succeed in electricity—whether he is a beginner or an experienced man. It gives you the benefit of a lifetime of practical electrical experience.

Send for the Burgess Catalog for complete information.

ELECTRICITY TAUGHT BY A PRACTICAL MAN

A FAIR AND SQUARE STATEMENT

I have been training ambitious men, both young and old, in practical electricity for a number of years by my Home Instruction Method, and would like to send you my catalog, which tells exactly what I do and HOW I DO IT. It also tells why, when and where my students succeed and HOW THEY DO IT. The catalog costs you nothing—it obligates you in no way whatever, but, for your own good, send for it, as it contains things you should know.

YORKE BURGESS, Supt.

BURGESS ELECTRICAL SCHOOL
Dept. F. 745 East 42nd St., Chicago, Ill.

A Practical Home Study Course

INSTRUCTION
The instruction is no cut and dried book plan, but is actually prepared with a view of fitting the individual. In this way one who is slow has the same advantage as others.

COMPLETE ELECTRICAL OUTFIT
Including Apparatus, Tools and Material, is supplied with the course without extra charge.

ELECTRICAL DRAFTING
This is a part of the regular work and certain drafting implements and materials are furnished students without any additional charge.

ELECTRICAL SLIDE RULE
I have written 20 lessons on this subject which are now included as part of the regular course in addition to the lessons on Electricity and Drafting. I am also supplying a Slide Rule and leather case to each student without charge.

Send Coupon For Catalog and Full Information

YORKE BURGESS, Supt.
Burgess Electrical School, Dept. F, 745 East 42nd Street, Chicago, Illinois.

DEAR SIR:—
Please send me your catalog, which explains your Home Instruction Course and the Burgess Service Method.

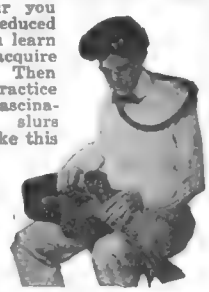
Name .....
Address .....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Play the Hawaiian Guitar

Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs and other effects that make this instrument so delightful.



The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Your tuition fee includes a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 complete lessons and pieces of music.

Special arrangements for lessons if you have your own guitar.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK

I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc., etc.

Name .....
Address .....
Town..... State.....E. E.

Write Name and Address Clearly

A Valuable Book FREE BRINGS BIG PAY

Do you want to increase your income by home study in your spare time? Our new catalog of home self-helps will show you how. No matter what your line of work, you will find in our FREE CATALOG of self-help books many valuable suggestions as to how you can easily increase your income. Especially valuable to all interested in Electricity, the Automobile, Machine Shop, Carpentry, Painting, Farm Mechanics and Machinery, Gas and Steam Engineering, Railroading or Modern Languages.

Sent ABSOLUTELY FREE. A postal will bring it. Send for your copy now.

Frederick J. Drake & Co.
1009 Michigan Ave. Chicago

Free Book
Containing complete story of the origin and history of that wonderful instrument—the

SAXOPHONE

Easy to Play
Easy to Pay

This book tells you when to use Saxophone—singly, in quartettes, in sextettes, or in regular band; how to transpose cello parts in orchestra and many other things you would like to know.

You can learn to play the scale in one hour's practice, and soon be playing popular airs. You can double your income, your pleasure, and your popularity. Easy to pay by our easy payment plan.

MAKES AN IDEAL PRESENT

Send for free saxophone book and catalog of everything in True-Tone band and orchestra instruments.

BUESCHER BAND INSTRUMENT CO.
604 Buescher Block, Elkhart, Ind.

THE ALSOP-ALL-SPARK

BEST BY GOVERNMENT TESTS

This simple little device does away with Spark Plug and Carbon Troubles, pays its owner big dividends. Ask for copy of report showing severe U. S. Govt. Tests. You Cannot Afford to Be Without It. It saves spark plugs, gasoline battery and starter—Eliminates Carbon—gives your car greater power—will fire old or cracked plugs no matter how full of oil or grease. Insures a hot spark. Prevents misfires. Makes starting easy. Send your order today and put an end to your engine troubles. Cost complete, with Money-Back Guarantee, $7.50

ALL-SPARK IGNITION CO.
Mail Order Dept.
13 Water St., N.Y. City

DENINGER WILL SAVE YOU 25 TO 50 DOLLARS

$40

BIG MONEY SAVINGS FOR YOU

Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies. Send for catalog. Deninger Cycle Co., Rochester, N. Y.

Recent Work of the Bureau of Standards

(*Continued from page* 1326)

LARGE ELECTROMAGNET FOR MAGNETO-OPTICS.

This electromagnet is used for studying the effect of magnetism upon light. It takes 100 amperes at 240 volts and is water cooled. It is perforated along the axis to allow a beam of light to pass thru. A polariscope is shown set up on the end pillars—the polarizer at the far end and the analyzer at the other. The strength of the magnetic field is measured by means of a Bismuth Spiral or a test coil (both shown on the small table) in conjunction with the accessory apparatus (shown on the left), mutual inductance galvanometer, milliammeters, sliding resistance, etc. The apparatus as shown is arranged for studying the effect of temperature on the rotation of crystal quartz, a crystal of quartz being placed in the small cylindrical furnace between the poles of the magnet.

Fascinating Experiments in Chemistry

By O. IVAN LEE

(*Continued from page* 1314)

The glycerine is uneasy and begins to bubble—then smokes and fumes. In a flash, the whole mass bursts into a hot and dazzling violet flame resembling a miniature volcano, for sparks and clouds of smoke are not lacking to complete the illusion. It will need little imagination to conjure the possibilities of such chemicals starting trouble if broken cases should get them to rubbing elbows in transit. Fortunately, there are not a great many combinations which are so energetic, but the moral is: No matter how mysterious the fire—there's always a reason!

HOW "RED CROSS" KEPT LIGHTS GOING.

Along with keeping "the home fires burning," the Transportation Department of the "American Red Cross" considers it also essential to keep its office lights shining. To this end, by providing its own electric light by means of a rather novel agency, it has given Paris its latest American sensation, the one preceding it, being the afternoon when Major George H. Robertson, head of the department, stood at the junction of two of the city's most congested thorofares giving Paris policemen his ideas on how to regulate traffic.

Recently the city authorities notified the headquarters of the Department at No. 4, Avenue Gabriel, that there would be no "juice" for the electric lights between the hours of 9 a.m. and 3 p.m. Fuel is scarce in Paris and must be used sparingly. Now this particular day happened to be dark and foggy with much work to be done in the department. Some had visions of a holiday, for without light it was practically impossible to figure up long columns of gas consumption, finance, or play on a typewriter. That idea, however, was rudely dispelled, for a telephone message to the Red Cross garage brought out a big Crochat repair car, equipt with powerful generators and heavy cables.

Within a few minutes after its arrival, the motor was snorting away in the street, and the generators were sparkling and sending out over the cables into the building sufficient current to furnish the light for every lamp there. Standing as it did on a much frequented thorofare, the big car attracted considerable attention.

Ride a Ranger

the finest bicycle ever built—any where at any price. Select from 44 Styles, colors and sizes made in our three big model factories.

SAVE $10 to $25 on your bicycle. Pay cash or take advantage of the 12 months to pay plan. Many parents advance first small deposit and energetic boys and girls easily earn the small monthly payments.

30 DAYS FREE TRIAL on the Ranger you select. Costs nothing unless you are satisfied. Delivered free on approval.

Tires lamps, horns, wheels, parts, all equipment for bicycles below usual prices. WRITE TODAY for full information. Big, Free illustrated catalog, factory prices and terms as well as Rider Agent offer. Don't delay. Do it now.

Mead Cycle Company Dept. D-107 Chicago

ADD TO YOUR INCOME
$5 TO $10 A DAY MADE EASY

The New Improved Am. Jr. No. 2 is A Wonder

Sharpens and strops ordinary razors. Sharpens razor blades, scissors, etc.

Complete outfit for only $5

AM. SHARPENING MACHINE CO.,
184 Washington St., Chicago

EASIEST SHORTHAND

Learn in 5 evenings home study; then acquire speed with K. I. Shorthand. Amazingly simple, easy. Approved by experts. Write dictation, messages, etc., rapidly as spoken, after brief pleasant practice. Favorite method for personal use; make notes at lectures, meetings; keep confidential diary. Big help in any profession or business; aid in your career. Used in Army, Navy, courts, commercial schools; by public and private stenographers, teachers. Silent cost. K. I. Shorthand—for busy people, including YOU. Proof Lessons, Guarantee and Brochure with testimonials free, postpaid. Address

KING INSTITUTE, EP-300—Station F, NEW YORK CITY

SPEED LATHE $10.50

Longer bed $1.00 per additional foot

Head has 3-speed cone No. 1 Morse Taper Shank Centers, 3-8 in. hole thru spindle. Tail Stock has screw feed spindle and No. 1 Morse Taper Shank Center. 3 1-2 in. Face Plate $1.25. Spur Center for Wood Turning $1.00.

CENTRAL MANUFACTURING CO. FAIRFIELD, IOWA

INVENTORS

MODELS EXPERIMENTAL WORK

Are you looking for a reliable concern to assist you in developing that idea that you just can't work out? Consult us. With our staff of expert engineers and thoroughly equipped experimental machine shop, we can develop any proposition for you, mechanical or electrical, and *make it work*.

We develop, simplify and perfect inventions, make them commercially possible, and build working models. We design and build special automatic labor saving machinery.

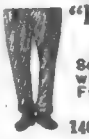
All business strictly confidential and protection guaranteed.

ELK MFG. CO., INC. 1926 Broadway, New York

DO YOU WANT
Prosperity! Power! Happiness! ?

Positive Wonderful Results by Our System. "Success" Lesson and Personality Sketch for 10c and birth date.

THOMSON-HEYWOOD CO.
Dept. 350 Chronicle Bldg. San Francisco



"BOW LEGS and KNOCK-KNEES" UNSIGHTLY

Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.

PERFECT SALES CO.
140 N. Mayfield Ave., Dept. 50, Chicago, Ill.

STAMMER

If you stammer attend no stammering school till you get my large FREE book entitled "STAMMERING, Its Origin and the Advanced Natural Method of Cure." Ask for special tuition rate and a FREE copy of "The Natural Speech Magazine." Largest and best school for stammerers in the world. Write today. The North-Western School, 2331 Grand Ave. Milwaukee, Wis.

SECRET SERVICE

Operatives, Detectives and Investigators are in big demand; earn big salaries; fascinating work. Be independent. We show you how by home study. Write American School of Criminology, Dept. E, Detroit, Mich.

BOUND VOLUME No. VI

Of ELECTRICAL EXPERIMENTER

(*Issues of May, 1918, to April, 1919, inclusive*)

Contains hundreds of interesting articles and illustrations. The material contained would cost thousands of dollars to assemble in any other form.

Do not delay a single day. The best volumes will be mailed out first. Mail your order at once, and you will receive your volume by return mail.

Special Price, $1.75
Plus Postage for 8 Pounds

This is less than the actual subscription price. Mail your remittance today.

Book Department Experimenter Publishing Co.,
New York City
233 Fulton Street,

Digitized by Google Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

DETROIT

The Auto Center is the Logical Place To

LEARN AUTOMOTIVE ELECTRICS

Training for Head and Hand

A few weeks of M. S. A. S. factory outlined training has put thousands of men into big money jobs or started them in business for themselves. It can do the same for you. Previous experience is not necessary. At the M. S. A. S. you learn automobiles and tractors from A to Z. You learn the way the men who built the machines say you should learn. The leading manufacturers, their engineers and service managers know their business, and they endorse our methods. Our courses were planned and are given as outlined by these leaders of the industry.

Unlimited Opportunities

The big rush of repair and service work is on; there is no limit to the opportunities for trained men. You can start a garage, repair shop or service station of your own. Production is again increasing and trained men are moving forward. Trained men are needed to operate, repair and sell tractors and automotive equipment used on the farm. Experts are needed to install and do service work on lighting systems. Salesmen who understand mechanics and electrics are winning big success. More brazing and welding shops, more tire repair shops are needed. There is no other line of business where a man can go out and do what our graduates do in such a short time. Many of our graduates who had no experience before training now

Make $500 to $1000 a Month

H. A. BRADLEY was working for $12.00 a week. Says he didn't know a carburetor from a magneto. He trained at the M. S. A. S. and now has a garage business of his own in Cleveland, paying a profit of over $500 a month.

J. S. STECKLE, of Coplay, Pa., was working for small pay. He trained at the M. S. A. S., increased his income to $100 a week. Mr. Steckle also made a good record in the army, due to M. S. A. S. training.

ELDRIDGE BROOKS, of Meadville, Pa., is just 18 years old and has a garage business of his own with sales agency for Oakland and Nash cars. This is a splendid record for a young man just 18.

OSCAR PETERSON, of Denmark, came to the U. S. A. to learn the auto business. M. S. A. S. training has done much for him. He has a thriving business of his own in Denmark and says he owes his success entirely to M. S. A. S. training.

C. F. SWANSON, of Sioux City, Ia. Before training at the M. S. A. S., Mr. Swanson was working by the day. He now has a business of his own and makes over $500 a month. He attributes his success absolutely to M. S. A. S. training.

CHAS. CHAMBERS, of Oakton, Ky., is farming 3,000 acres of land. Says he would find it impossible to farm without tractors and other motor equipment and that his M. S. A. S. training saves him many hundreds of dollars each season.

This is 20-year-old **BEN KOEHLER**, M. S. A. S. graduate, at Pulaski, Wis. He has done $93,810 worth of business with $10,000 profits in six months.

Leading Manufacturers Say

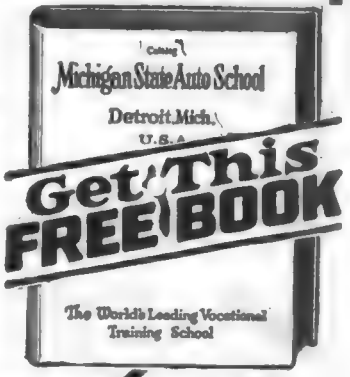
Train at the M. S. A. S.—the manufacturers know from experience that M. S. A. S. trained men know their business. In fact many of the leading manufacturers, their service managers, engineers and officials assisted in outlining M. S. A. S. courses. They know M. S. A. S. courses are right. They recommend M. S. A. S. training because of its factory outlined system. Nowhere else can this factory outlined, factory endorsed course be found. Therefore, get your training as recommended by leaders of the industry.

Showing individual work on motor in M. S. A. S. block test

Now Is The Time To Start

This is the very best time to get your training. All the latest automobiles and tractors are now in our equipment. Hundreds of men are coming every week from all parts of the country and are going back in ten weeks with a training that will enable them to get the best job and to start businesses for themselves.

There is nothing ahead but success for the man with an M. S. A. S. training and an ambition to get ahead. If you have this ambition, write today for our free 124-page catalog and information on the auto industry. Or, better still, take the first train to Detroit, look over the M. S. A. S. and then decide.



MICHIGAN STATE AUTO SCHOOL
"The Detroit Auto School"
Endorsed by all Leading Automotive Manufacturers
664 Auto Building, 3729 Woodward Avenue
DETROIT, MICHIGAN, U. S. A.

MICHIGAN STATE AUTO SCHOOL
664 Auto Building, 3729 Woodward Ave., DETROIT, MICH.

Gentlemen: Please send me absolutely FREE New 124-page Illustrated Catalog, "Auto School News" and information as checked below.

[ ] Auto and Tractor Course
[ ] Tire Repairing
[ ] Brazing and Welding

(Mark each course you are interested in.)

Name.....
Street.....
City.....
State.....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

The VIRAZONE

in its functions and accomplishments, is science's medicine chest in combination with a miniature beauty parlor.

Mechanically, it is a self-contained high-frequency instrument with all the current efficiency of the more elaborate and costly professional apparatus. Attached to any electric-light fixture it transforms the current (direct or alternating) into Violet Rays and Ozone in all their purity. Though highly technical in design and assembly it is as simple, safe and economical in operation as a light-bulb.

The VIRAZONE responds with reliable constancy to all the varying demands for volume and intensity. Whether the subject under treatment be a delicate infant with "every nerve on fire" or an aged paralytic, devoid of sensory reaction, the simple turning of a knob calls into immediate action the gently soothing or the intensely stimulating rays. All bodily ailments, ranging in gravity from pimples to paralysis, are effectually cured or greatly benefited by the tremendous energizing impulses of the Violet Rays and the peculiar oxidizing and cleansing property of Ozone.

The VIRAZONE "gets under the skin" and deep into the underlying tissues without the stretching and sagging that follow the use of the prevailing type of vibrator.

Whether suffering from some serious malady or embarrassed by some annoying affection or condition of the skin or scalp, the VIRAZONE is your confident hope.

The VIRAZONE is a marvel of compact efficiency, extremely moderate in price and guaranteed for all time against mechanical deficiencies of every nature and kind. Regardless of what it is doing for others, you want to know what it will do for you.

Apply to your favorite drug or electrical dealer today for a ten-day free trial. If he cannot supply you promptly, write us, and we will.

THE VIRAZONE COMPANY

1300-5 Absopure Bldg.,
DETROIT, MICH., U. S. A.

JUNIORPHONE

A THERMO TELEPHONE
-WITH-
COMPLETE TALKING AND SIGNALLING SYSTEM
A PRACTICAL SCIENTIFIC TELEPHONE OPERATING ON A NEW PRINCIPLE.
EASILY ASSEMBLED FOR INSTANT USE
CAN NOT BE EQUALLED AS A DISTINCTIVE, INSTRUCTIVE AND INTERESTING NOVELTY.
APPEALS TO ALL UP-TO-THE-MINUTE YOUNGSTERS AS WELL AS TO THE GROWN UPS.

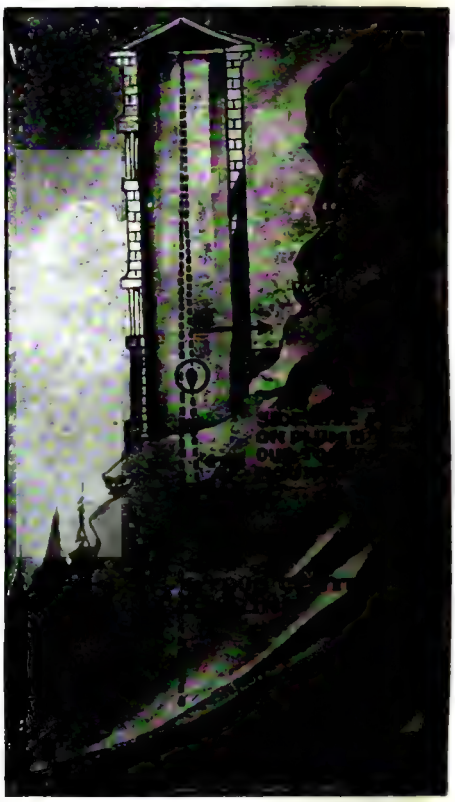
MANUFACTURED BY
AMERICAN THERMOPHONE COMPANY
114-116 BEDFORD ST. BOSTON, MASS.

Oddities of Physics

By H. WINFIELD SECOR

(*Continued from page* 1285)

building a wall one mile long, the difference between the actual wall as constructed by leveling with spirit levels, and a dead straight line (sighted across the top of the wall by using a leveling telescope or surveyors instrument) is one-half foot. In other words, if the wall was constructed two miles long by leveling, the top of it would curve upward in the center, so that if a perfectly straight line or chord were drawn across the top of the wall, there would be one-half foot difference between the line and the top of the wall at either end. For longer walls this difference increases of course, and decreases as the wall becomes shorter.



The Illustration Above Shows, Greatly Exaggerated of Course, How a Mountain or Hill Exerts a Sidewise Gravitational Pull on a Suspended Plum Bob, for Example. That Is, If a Tower Were Built by Means of a Plumb Bob on the Side of the Mountain in the Position Here Shown, the Tower Would Not Be Straight But Would Lean Away from the Mountain, (Unless Precautions Were Taken to Allow for the Sidewise Pull of the Mass of the Mountain, of Course). This Difference Would Not Be Very Much,—But the Higher the Tower, the Greater Its Magnitude.

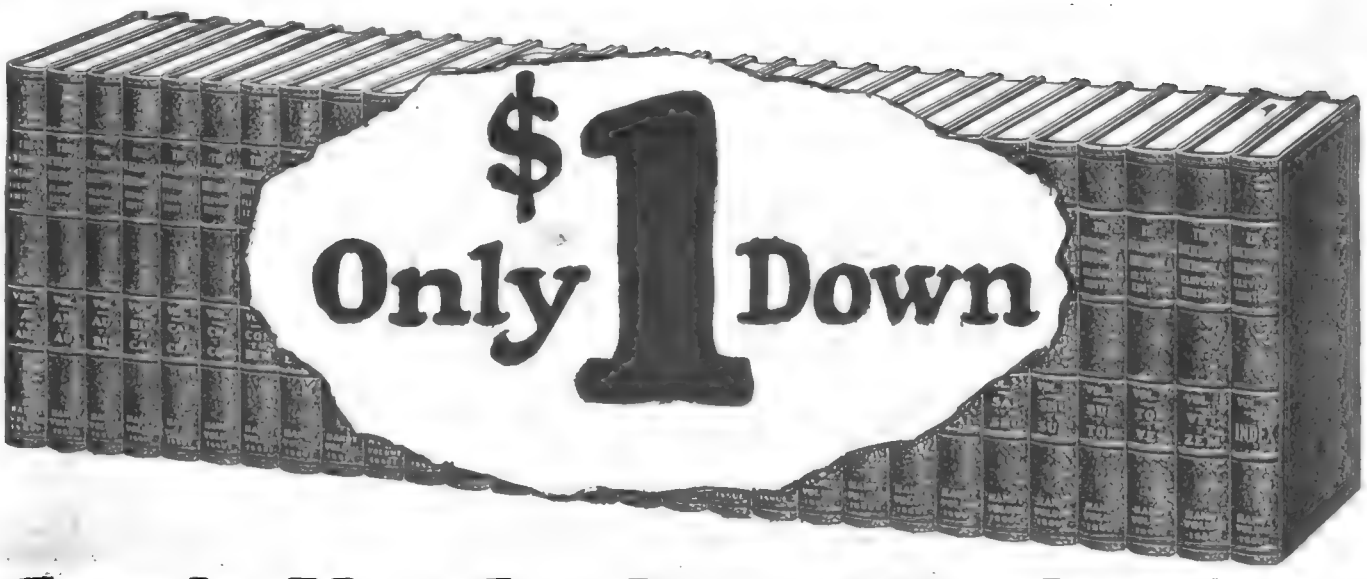
HOW MOUNTAINS ATTRACT MASSES.

It is a well known fact in physics that if we suspend a mass, such as a leaden sphere, whether small or large with a cord by the side of a mountain or hill, this promontory will exert an attraction for the suspended mass, and which varies with the respective sizes of the mass and of the mountain.

The particular consideration we are interested in here is that if we were to construct a tall chimney or tower on the side of a mountain and line this up presumably vertically with a plumb line and bob, then as the diagram, Fig. 4 shows, the tower would not be exactly vertical, but would lean outward from its base, owing to the attraction between the plumb bob and the mass of the mountain which, altho

(*Continued on page* 1332)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



Surely, You Can Now Afford to Own This Great Library of Knowledge

Sets of the Encyclopaedia Britannica in the Popular Handy Volume Issue, Printed on the Famous India Paper, Are Offered at Prices Within the Reach of Everybody

ARE you one of those who do not own a set of the wonderful Encyclopaedia Britannica because you THOUGHT you couldn't afford it?

Have you wanted this splendid library of facts ever since you first heard about it but NEVER INQUIRED how easily it could be purchased?

This book will give you a tremendous advantage.

Think, too, what it will mean to you, to your children, to have in your home—to have constant access to the SUM and SUBSTANCE of ALL HUMAN KNOWLEDGE.

Consider what a satisfaction it will be to have at hand THE ANSWER TO EVERY QUESTION which comes to an active mind.

The Britannica covers the whole range of man's thought and activity and achievement—it contains more than 41,000 special articles, more than 500,000 indexed facts.

Both for profit and pleasure

THE ENCYCLOPÆDIA BRITANNICA

Is one of the best investments any ambitious man or woman can make. To briefly describe its scope is impossible. It contains hundreds upon hundreds of articles on religion, philosophy, history, art, science, literature, manufacturing, engineering, law, physics, commerce and scores of other subjects—41,000 articles in all. It abounds in everyday useful facts that satisfy the inquisitiveness of the child mind, that enlighten the housewife, the farmer, the business man, the investigator, the educator and the lawyer.

Men and women in all walks of life are among the 200,000 owners of the Eleventh Edition.

IF YOU DO NOT OWN THE BRITANNICA, WHY NOT?

This is your opportunity to own an India paper set.

These sets are printed on the beautiful, genuine India paper.

As you know, this very thin but strong India paper makes this great work more convenient to handle, more inviting to read.

These sets are offered at prices and terms which make the Britannica a bargain to anyone who does not yet own a set.

$1 ***As First Payment Brings You This Complete Set of 29 Volumes Containing 44,000,000 Words, 30,000 Pages, 15,000 Maps and Illustrations. The Balance Is in Small Monthly Payments.***

Remember, this is an unusual offer of the complete Britannica printed on genuine India paper. Act today—NOW—by clipping the coupon and sending for the beautifully illustrated book, which is sent without charge, telling all about the Britannica.

If you are ready to subscribe now, write an order on a piece of paper and mail with a dollar bill and we will give your order prompt attention.

Sears, Roebuck and Co.
CHICAGO

Sign and Send This Coupon Today.

Sears, Roebuck and Co., Chicago, Ill. 26U

Gentlemen: Please send me your illustrated Book, giving full information about the Encyclopaedia Britannica. Also tell me what I will have to pay for a set of the Handy Volume issue of the Britannica printed on genuine India paper.

Name .....

Postoffice .....

R. F. D. No..... Box No..... State.....

Street and No.....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ONLY
$8.45
Sent on Approval

for actual $18 value—
Tenor Banjo, Banjo or Banjo-Mandolin—

Sensational, direct-from-the-factory price. PROFESSIONAL TONE instruments, guaranteed 10 years. No. 2 Tenor-Banjo, No. 3 Banjo and No. 4 Banjo Mandolin have 11 in. heads; nickel-plated brackets and tail pieces; Champion pegs; fine Calfskin heads, nickel-plated shell, both edges spun over steel wire. Artistic scroll heads. Worth $18.00. Our rock-bottom, direct-from-the-factory price only $8.45 each; No. 5 Banjo-Ukelele, 7 in. head, same style, only $6.45. Also have beautiful laminated Bird's eye Maple shell, 3 piece neck, elaborate pearl inlay, Banjo, Tenor-Banjo, Banjo-Mandolin; $65.00 value. Our factory price, $18.85. Violin and Bow, $25.00 value, $11.95. Make big money. We want customer agents everywhere. Select your instrument and in evidence of good faith, send $1.00 today. Will ship C.O.D. balance with privilege of examination. You will get an instrument you will be proud to own. If not worth 2 or 3 times amount we ask, do not accept it, and we will refund your dollar. Hurry! This offer may not appear again.

Chicago Musical Instrument Mfg. Co., Desk 802. 602 W. North Ave., Chicago

EVERYTHING You want to know About A. C. Motors and Repairing

Whenever any question arises regarding motors, or if you are anxious to become a specialist on electrical motor work, you need the

ELECTRICAL WORKERS FRIEND

An invaluable collection of diagrams and instructions for electrical workers, students, amateurs, etc.

This book contains 66 motor diagrams with complete instructions for rewinding and reconnecting A. C. Motors. Shows how to put each coil in the slots, giving all internal and external connections. For reconnecting they cover all practical changes showing which diagram to use for the change wanted. Bound in loose leaf form for handy reference. The only complete book of its kind on the market. So simple anyone can understand. It is helping thousands of other workers—it will help you too, as hundreds of testimonials prove.

SPECIAL PRICE, COMPLETE $4.00. Order today. If desired we will ship C. O. D. by Parcel Post, U. S. only.

YOU CAN EARN YOUR COPY FREE

We offer all owners of the Electrical Workers Friend a commission of 50c on every book they help us sell. All you have to do is show your book and recommend it. You can earn the full price of one of these books in a few days. Write immediately for full particulars—this offer is limited.

SMITH & SMITH PUB. CO. 1524 Lowrie St., N. S. Dept. B, Pittsburgh, Pa.

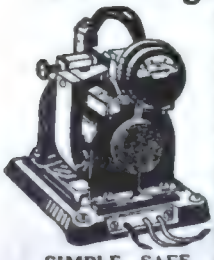
ELECTRIC LIGHT IN YOUR HOME $1.00

The latest electric light, as batteries to buy or electric bills to pay. Anyone can install and maintain this midget electric light. Safe, simple and inexpensive. No more smoke and smell, no wicks or oil, no chimneys to clean or break, just as safe in the barn, garage and clothes closet as in any open room, always ready for use, day or night. A touch on the switch and you instantly have a bright electric light. No matter where you live this light can be installed. It is not affected by heat or cold. Many homes have installed this electric light in their halls, closets, pantries, barns, sheds, cellars, garages, etc., with good results. It is an extremely useful light which no household should be without. The reason for this bright electric light is that the lighting bulb is fitted with a drawn Tungsten filament wire which is much more efficient and durable, besides giving a 300% increase in light as compared with the ordinary carbon lamp. The power system furnished with this lighting outfit is somewhat similar to the electric power battery described. Each electric light outfit includes the following: Complete directions and plans, copper wire, insulated wire holders, knife switch, drop light fixture with socket, friction tape, battery protector, maroon shade, national mazda globe. Our dry battery compound, which assists in renewing and supplying the current and our current renewing system with which you can renew the current at home without expense. With every day use one recharge usually lasts two to three weeks. This electric lighting outfit is undoubtedly the most practical and durable electric light of low cost and long service ever devised. Special price to introduce these electric lighting outfits $1.00, prepaid. Outside the U. S. $1.25.

ADAMS BROS. Peoria and 13th Streets, CHICAGO

Auto Owners—Battery Users—Wireless Operators—Experimenters

10c Charges Your Battery AT HOME WITH AN F-F Battery Booster



SIMPLE—SAFE SURE ACTING

or Magnetic Rectifier for 105-125 Volt 60 Cycle Alternating Current at a 1914 Price. F-F Battery Boosters are entirely automatic and operate unattended. Adjustable Carbon Electrodes rectify the current and operate for thousands of hours.

Screw the plug in lamp socket in your garage, snap charging clips on battery terminals without disconnecting or removing battery from car, turn switch and lock garage door, knowing your battery will be charged in the morning. Keeping your Starting Storage Battery in charged condition makes it delightfully responsive and lasts so much longer, requiring fewer expensive battery renewals, that it actually costs you less to buy a Booster than to be without one.

Bantam type 6-6 ampere for 6 volt battery . . $15
Type 16-8 ampere for 6 volt battery $24
Type 166-12 ampere for 6 volt battery $32
Type 1626-12 amperes or 7 amperes in combination for both 6 volt and 12 volt batteries $48

Bantam type 12-5 ampere for 12 volt battery . $15
Type 112-6 ampere for 12 volt battery $24
Type 1612-7 ampere for 12 volt battery $32

High ampere charging rates are best for large batteries, or where time is limited. Shipping weight complete with **AMMETER** and **BATTERY CLIPS**, 11 to 15 lbs. Include postage and insurance with remittance for parcel post shipment. Other F-F Battery Boosters for Farm Lighting Plants and Direct Current Battery Stations and Garages. Ask the F-F Rotary Rectifier for Group Charging.

WRITE FOR BULLETINS 12 AND 12-A OR MAIL CHECK WITH ORDER

THE FRANCE MANUFACTURING CO. Offices and Works, Cleveland, Ohio

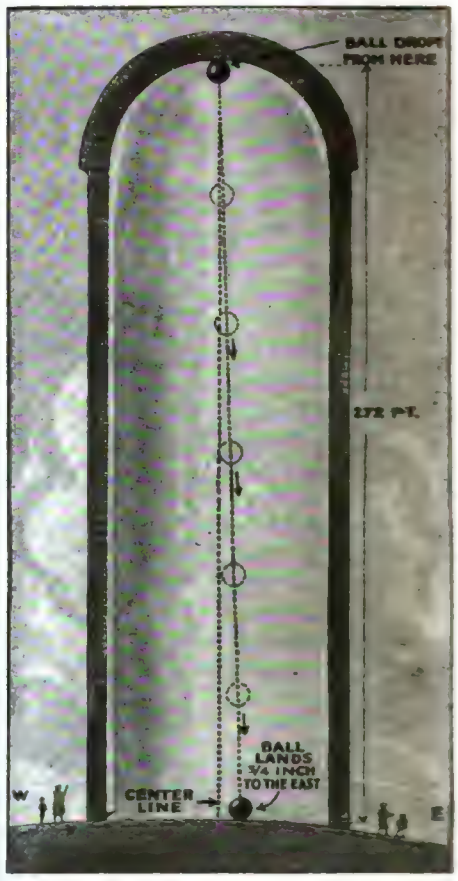
Oddities of Physics

(*Continued from page* 1330)

extremely slight, might become quite an appreciable factor to reckon with in a tall structure. About the simplest way to check up the perpendicularity of the tower or other structure would be by means of a surveyor's theodolite.

DOES AN OBJECT WEIGH THE MOST ON THE EARTH'S SURFACE?

If you want to start a good "rainy day" argument at the club or in the smoking car, just ask the question, "Where does a cannon ball weigh the most,—at the surface of the earth, below the surface, or above the surface?" Due to two well defined laws of Nature, we come to the conclusion, that the object, whatever it may be, weighs its greatest at the earth's surface. The law of weight with respect to distance which concerns the present problem has



An Iron Ball or Other Weight Dropt from an Elevation Such As the Top of a 272-Foot Tower Here Shown, Will Land to the East of the Point Directly Under the Central Point from Which It Was Dropt, the Ball Landing on the Average ¾" to the East. Fig. 6.

been formulated as follows: "The weight of a body varies directly as the mass, and inversely as the square of the distance between its center of gravity and that of the earth."

This is shown in the accompanying illustration, Fig. 5. A 100 pound ball, that is, one weighing 100 pounds at the surface of the earth, will weigh but 25 pounds when four thousand miles above the earth's surface. Since the weights of objects above the earth are inversely proportional to the squares of their distances from the center of the earth, we find that w, the weight at any elevation is to W, the weight at the surface, as D^2—the distance in miles from the surface to the center of

(*Continued on page* 1334)

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

"Good Bye, Boys!"

"Today I dropped in for a last word with the boys at the office. And as I saw Tom and Dave there at the same old desk it came to me suddenly that they had been there just so the day I came with the firm four years ago.

"When I started here I was put at a desk and given certain routine things to do. It was my first job and I took it as a matter of course. But after a few months I began to realize that I was nothing but a human machine, doing things that anyone could do, and that I couldn't expect to advance that way.

"So I had a talk with the manager and I'll never forget what he said. 'If you want to get ahead, put in some of your spare time getting special training along the line of your work. We want men who care enough about their future not only to do their work well but to devote part of their spare time to preparation for advancement.'

"That very night I wrote to Scranton and a few days later had started studying evenings at home. Why, do you know, it gave me a whole new interest in our business? In a few months I was given more important work and more money. Since then I've had three increases, six months ago I was put in charge of my department, and now my big chance has come—I'm to be manager of our Western branch at $5,000 a year!

"Tom and Dave could never see any sense in my studying nights—they said eight hours a day was enough for any man to be bothered with business. They had the same chance I had—they could have been big men in the firm today. But they stood while I went up to one of the best jobs in our business. It just shows what spare time training will do."

Every day men who have let the International Correspondence Schools help them are moving up to more responsible positions and bigger salaries. Clerks have become advertising, sales and business managers; mechanics have become foremen, superintendents and engineers; carpenters have become architects and contractors; men and boys have risen from nothing at all to splendid positions of responsibility—because in spare hours at noon and at night they have learned to do some one thing well. If *you* want to make more money, show your employer you're trying to be *worth* more money. If you want a bigger job, show him you're willing to *prepare* for it.

There's a simple easy way to do it. For 29 years the International Correspondence Schools have been training men and women right in their own homes whenever they had a little time to spare. More than two million have stepped up in just this way. More than 130,000 are studying now. Ten thousand are starting every month.

Can you afford to let another priceless hour pass without finding out what the I. C. S. can do for you? Here is all we ask—without cost, without obligating yourself in any way, mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 6186-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ Pharmacy
☐ Electric Wiring	☐ SALESMANSHIP
☐ Electric Lighting	☐ ADVERTISING MAN
☐ Electric Car Running	☐ Show Card and Sign Painting
☐ Heavy Electric Traction	☐ RAILROAD POSITIONS
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BUSINESS MANAGEMENT
☐ Practical Telephony	☐ Private Secretary
☐ MECHANICAL ENGINEER	☐ Business Correspondent
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Toolmaker	☐ Stenographer and Typist
☐ Machine Shop Practice	☐ Cert. Public Accountant
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ Common School Subjects
☐ MINE FOREMAN OR ENGINEER	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ STATIONARY ENGINEER
☐ PLUMBING AND HEATING	☐ Textile Overseer or Supt.
☐ Sheet Metal Worker	☐ AGRICULTURE ☐ Spanish
☐ Ship Draftsman	☐ Navigator ☐ Autos
☐ Traffic Management	☐ Poultry Raising ☐ Banking

Name_____

Present Occupation_____ Business Address_____

Street and No._____

City_____ State_____

Canadians may send this coupon to *International Correspondence Schools Canadian, Ltd., Montreal, Canada* 1-1-21

Digitized by Google Original from UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

ON CREDIT
DIAMONDS
WATCHES
Send For Catalog
DIAMONDS WIN HEARTS
Special Bargains
in Diamond Engagement Rings and Solid Gold and Platinum Wedding Rings, Diamond-Set
Also a splendid assortment of the new engraved, pierced Rings, White and Green Solid Gold, fine brilliant Diamonds; Diamond La Vallieres, Bar Pins, Ear Screws, Scarf Pins, Cuff Links, Watches, Wrist Watches, etc. Send today for Catalog and make your selections. We pay all shipping charges.
Loftis Lady Louise Diamond Ring
Credit Terms on purchases of $35 or over, one-fifth down, balance in eight equal amounts, payable monthly. LIBERTY BONDS ACCEPTED.
LOFTIS BROS & CO. 1858
The National Credit Jewelers
Dept. M-22 108 N. State St. CHICAGO, ILL.
STORES IN LEADING CITIES

ROTH
PROTRACTOR
DRILL LEVELS
$2.00
Will make your drill "STAY ON THE LEVEL"
When you know that you can drill holes accurately at any angle, you will want a Roth Protractor Drill Level. Easily attached to any kind of drill. Hand-Chain or Electric. It saves time and assures better work.
You know what this Level will do for you. Mention type of drill you are using. Postage prepaid.
PROTRACTOR LEVEL CO.
620 Arctic Avenue Atlantic City, N. J.

From factory to you—FREE
Easiest riding, most comfortable wheel built. We'll ship to you on approval. You'll surely want it when you see the 18 exclusive features of the wonderful 1921 model electrically equipped
BLACK BEAUTY
There's a large variety of models to choose from. Pick the one you like best. We'll ship it to you express prepaid on approval. A small deposit and a
DOLLAR A WEEK
makes you the owner. Our direct factory price saves you money. You get a liberal 5-year guarantee and 6 months' accident policy with every wheel.
Big new catalog in colors—FREE
Something every boy needs. It shows everything a bicycle rider wants at remarkably low prices. Send for it—NOW!
HAVERFORD CYCLE COMPANY
Established 25 years
Dept. 624 Philadelphia, Pa.
Be a Black Beauty Owner Agent.

HB This HB Battery Charger is My Biggest Money-Maker!
You Can Make $1500 to $3000 a Year Charging Batteries
Others are doing it—you can, also. It costs 4c to 12c to charge batteries, customer pays 75c to $2.00. Clear cash profits—no bulbs to burn out, no repairs or expensive renewals with H. B. Chargers
Small cash payment—almost a year to pay balance on Easy Terms.
H. B. Chargers in sizes for 10, 16, 32 or 70 batteries. Choose size you need, then write QUICK for information. Money back guarantee. Ten days free trial.
Hobart Bros. Co. Box 477E, Troy, O.
Start NOW to make BIG PROFITS

Oddities of Physics

(*Continued from page* 1332)

the earth squared, $4{,}000^2$ is to d^2—the distance from the center of the earth to the level at which the object is placed. Algebraically we have:

$$w : W = D^2 : d^2$$

or $w : 100 = 4{,}000^2 : (4{,}000 + 4{,}000)^2$

and $$w = \frac{100 \times 16{,}000{,}000}{64{,}000{,}000} = \frac{100 \times 16}{64} = 25$$

When we go *below* the surface of the earth we find that objects *weigh less as we progress towards the center.* In this case the decrease of weights follows a different law than that for bodies placed above the earth's surface. This last law states that *the weight of a body placed below the surface decreases as the distance to the center decreases.* That is, if the body is only one-half as far from the center as the surface is, it will weigh but one-half as much as on the surface This is due to the fact that the mass between us and the center of the earth becomes less and secondly, the force of direction is less. Thus the weight of a 180 pound ball or mass, 2,000 miles below the surface is but 90 pounds, or our 100 pound ball in the illustration, Fig. 5, would weigh but 50 pounds at a depth of 2,000 miles below the surface.

"FALLING EAST."

One of the most interesting and not so well known of physical phenomena is that known as "falling east." Dr. Daniel W. Hering in his work, "Essentials of Physics" states that inertia has been employed to demonstrate the rotation of the earth upon its axis; and furthermore, if the earth rotates, the top of a tower or mast moves faster than the bottom, which we perceive as being true upon consideration of the facts in the case.

The apex of Dome of the Pantheon in Paris is 272 feet above the floor, and the latitude of this structure is 48+ degrees; and for the earth to rotate once in 24 hours, the top of the dome or structure moves to the east faster than does the bottom of the tower, by .18 inch per second. A body requires 4.1 seconds to fall from the top of the dome to the floor; theoretically, therefore, the body should strike .75 inch to the east of a point directly under the plummet when dropt. This was born out by actual experiments, repeated many times, when an iron ball thus dropt, always fell to the east one-half inch to one inch away.

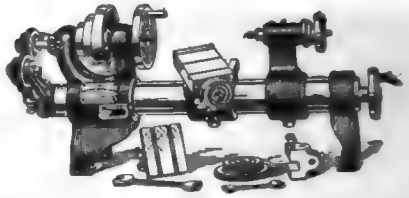
As Dr. Hering states, "This experiment may be interpreted either way, for if we regard the rotation of the earth sufficiently well proved, we may regard this experiment as confirming the principle of inertia."

WHICH IS THE MOST EFFECTIVE—A SHORT OR LONG HITCH?

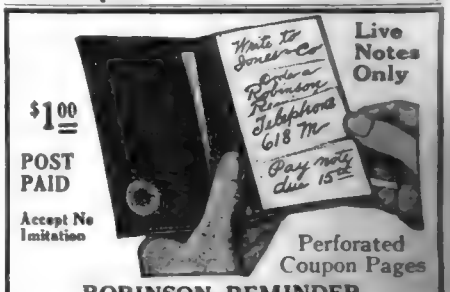
When it comes to a good argument in "applied physics,' one that will shake up the whole bunch and rattle the kitchen stove as well as the oil paintings in the parlor, and when you really feel like starting something, just spring this one: "Which is the most effective, —a short or long hitch when pulling a load?"

Fig. 7 illustrates what is meant more clearly. Usually of course it is the farmers' argument, or one frequently heard among those having to do with horses, that it is a well-known fact that

(*Continued on page* 1336)



Model-Makers—Inventors
Mechanics—Repair Men
ARE *YOU*
Looking for a Lathe that will do Turning, Boring, Drilling, Screw-cutting, Milling and Keyway-cutting, and *low* in price?
The "DRUMMOND" 8 inch Lathe
With Circular Bed
is the one you want!
Send for particulars
PRODUCTION EQUIPMENT CO., Inc.
Dept. 6
5 Union Square New York City

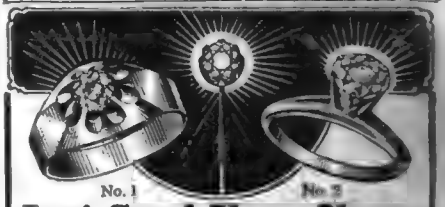


$1.00 = POST PAID
Accept No Imitation
Live Notes Only
Perforated Coupon Pages
ROBINSON REMINDER
Tear Out When Attended To
Each memo a perforated coupon, which when attended to, is torn out, Leaving Live Notes Only. No searching thru obsolete notes. Everything ready for instant reference. Pocket in cover.

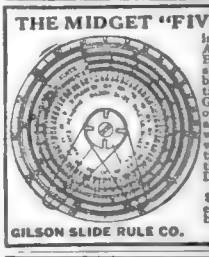
Reminder with extra filler	Size B 3x5 in.	Size A 3½x7 in.
Black Leather	$1.00	$1.75
Cross Grain Leather	1.50	2.50
India Calf	2.50	3.25
Cowhide	2.25	3.00
Genuine Morocco	2.75	3.75
Imitation Leather	.75	1.00
Cloth (without extra filler)	.25	.50

Ladies' Shopping Reminder With Pencil and Extra Filler	Size L 2¾x3¾
Black Leather	$1.25
Cross Grain	1.50
Patent Leather or Cowhide	1.75
Calf	2.00
Morocco	2.25

Extra Fillers—Per dozen: Size B, 75c; Size A, $1; Size L, 70c. Gold name on cover 25c extra. Prices changed without notice. If not at your stationer's, order from us. (Stationers write.)
Robinson Mfg. Co., 131 Elm St., Westfield, Mass.



Just Send Your Name
We want you to wear one of our sparkling oriental gems 10 days free. These wonderful new perfect cut gems have all the dazzling fire and brilliancy of a real diamond. The luxurious, blue white gems—each a carat in size—are perfect diamond cut, and absolutely flawless. Mounted in beautiful heavy high-grade 12K. gold s. ring, men's or women's style as illustrated
No Money Simply tell us which of the rings you want. We will send the ring you choose without one penny in advance. When ring arrives, simply deposit $3.65 with postman. After 10 days' wear, if you can tell it from a costly diamond, we will refund every cent of your money. (To determine proper ring size, send narrow strip of paper that meets around finger where it is to be worn.)
GEM IMPORTING CO., 654 W. Lafayette St., Dept. 42 Chicago, Ill.

THE MIDGET "FIVE-IN-ONE" SLIDE RULE

is a combination Mannheim, Log-Log, Add and Subtract, Polyphase and Binary Slide Rule. It will instantly add, subtract, multiply and divide any combination involving whole numbers, fractions, decimals and mixed numbers. Gives every possible root and power of every quantity. The graduations are printed on metal, coated with white celluloid and are grease and waterproof. While it is the most versatile calculator ever invented, its operation is simple and easily understood. Diameter 4 inches.
Price with 16 page Instruction Book, $1.50. Leatherette carrying case for extra, Catalogue Free. Your money back if you are not satisfied.
GILSON SLIDE RULE CO. Niles, Mich.

MEN
Intensely interesting booklet free.
Wonderful results.
H. Clyde Co., Washington, D. C.

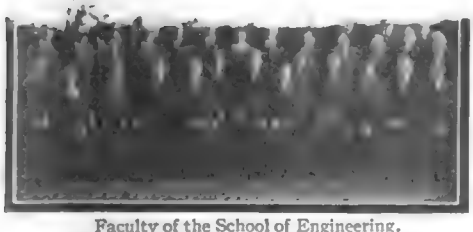
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Make Electricity Your Goal

Electricity holds brilliant opportunities for the man who is trained. Specialists are in demand everywhere at high salaries. Make electricity your life work and enjoy the rich rewards.

Edison, the electrical wizard, began his electrical career as a telegraph operator. He specialized.

Steinmetz, the world famous electrical engineer, is a member of our advisory board.



Faculty of the School of Engineering. The largest staff of any similar institution in the world. Includes recognized experts in every branch of electricity.

Fifteen years ago the S. of E. began in a little store of 500 sq. ft. Today it occupies the greater part of four modern buildings; 2300 students were enrolled in 1920. Modern study rooms, fraternity house, sports, athletics and other student activities.

How This Great Institution Trains You for the Master Job

You can develop your talent so that you, too, can be prepared for the big electrical job at handsome pay. Ninety leading electrical experts and instructors—the largest faculty of any similar institution, are here ready to personally direct you to SURE success. Every minute of your time here is made to pay you. We SPECIALIZE IN ELECTRICITY ONLY. You receive thorough theoretical knowledge as well as practical training in our well equipped laboratories. Fifteen years of specialization has taught us what non-essentials to eliminate. Instruction here is more thorough and personal. You learn more in a shorter time at less expense, and you can fill a definite place in industry when you graduate!

A PLACE FOR EVERY STUDENT

Whatever your age, your past education or present ability, there is a proper starting place for you here in this big electrical school. The chief requirement is ambition to succeed. We will place you where you belong and advance you as rapidly as your work permits.

EARN WHILE YOU LEARN

In addition you may be employed part time and study at school part time. Thus you may obtain actual practical experience and the salary earned helps pay your way through school.

JOIN OUR BIG STUDENT BODY

Over 2300 ambitious young men studied electricity here in 1920. In over 15 years we have trained thousands of electrical experts who have made their mark in every country of the world. If you want to make your mark in the great big world of electricity with its unlimited, high pay opportunities, don't experiment with untried, unsound methods of instruction. Investigate all that this world famous school offers you. Let it help you to make your dreams come true. Get the full particulars. Fill out and mail the coupon now and be that far ahead in the climb to your success.

MAIL THE COUPON, TODAY, FOR FULL INFORMATION ON THE COURSE YOU WOULD LIKE TO FOLLOW. SEE LIST OF COURSES.

School of Engineering
of Milwaukee

"Leading Electrical School of America"
Established 1905
MILWAUKEE, WISCONSIN

SELECT YOUR OWN FUTURE

Practical Electricity.—A six-months' course in installation and maintenance work. Eighth grade education desirable. Entrance any time.

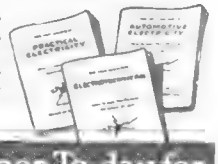
Electrotechnics.—Two and three year courses. Diploma admits without examination to College of Electrical Engineering. Common school and some high school credits required. Entrance any time.

Electrical Engineering.—Thirty-six months study. Degree of B. S. in E. E. granted. Open to men with full high school education or equivalent. Entrance every three months.

Armature Winding.—Three months full time. Common school education desirable. Entrance any time.

Drafting.—One year course. Common school education desirable. Entrance any time.

Automotive Electricity.—Three months' course on starting, lighting, ignition, storage batteries, farm lighting plants. Entrance any time.



MAIL the Coupon To-day for FREE Illustrated Booklets

SCHOOL OF ENGINEERING,
Dept. SI-4—Milwaukee, Wis.

Please send me information and illustrated book on—

Course.....

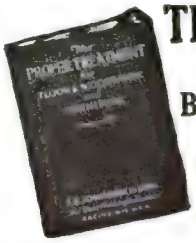
Name.....

Address.....

Town.....State.....

Age.....Education.....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



THIS BOOK ON HOME BEAUTIFYING Sent Free

Contains practical suggestions on how to make your home artistic, cheery and inviting. Explains how you can easily and economically keep the woodwork, piano and furniture in perfect condition.

BUILDING?

This book gives complete specifications for finishing both hard and soft woods in enameled effects with **Johnson's PerfecTone Enamel**—and in stained effects with **Johnson's Wood Dye.** We will gladly send you this book free and postpaid. When writing please mention the name of your best dealer in paints.

Tell your painter and architect that you want your floors and interior trim finished with Johnson's Artistic Wood Finishes. Then you will be assured of satisfactory results—a thrill of pleasure when the work is new and yearly satisfaction at its wearing qualities.

S. C. JOHNSON & SON
"The Wood Finishing Authorities"
Dept. SI. 4. Racine, Wis.

Selenium Cells

(NEW PROCESS)

Highly Sensitive. Quick Acting. Permanent. Uniform in Quality.

Sizes and types for all uses.

OFFER A NEW FIELD FOR THE INVENTOR

Send for illustrated Catalog A describing interesting electrical behavior of this metal under varying light conditions.

Richardson, Cook & Seixas, Inc.
154 Nassau St. New York, N. Y.

BLUE PRINT READING

CARPENTERS, Shipfitters, Bricklayers, Structural, Concrete and Sheet Metal Workers, Electricians, Mechanics, Plumbers, Pipefitters, Boilermakers—can you read Blue Prints and hold a big job? If not, learn how. It will help you hold your job—it will get you a better job—it will increase your earning capacity. DON'T DELAY—it means more money! Write for Catalog Bf stating trade.

BE A DRAFTSMAN
Earn $35-$150 Week

Draftsmen are in demand. Books and tools FREE. Write for Catalog G. DO IT TODAY!

Columbia Correspondence School Est. 1904
Dept 1, Drexel Bldg., Phila, Pa.

LAW IN YOUR SPARE TIME AT HOME

FOR BUSINESS FOR PROFESSION

Degree LL. B. Conferred

Study law with only Institution which gives same as was given for years at resident classes of this College. Business today demands a knowledge of law for those who want success. Big opportunities in the legal profession. We coach you free to pass Bar Examination in any State. Special consultation privileges. Complete 24-volume library (12 books) specially prepared by leading professional and law trained authorities. Our training is under the direct supervision of the Faculty of the College. Low tuition fee, easy terms. Write for Free illustrated book.

HAMILTON COLLEGE of LAW, 404 Morton Bldg., Chicago

Oddities of Physics

(*Continued from page* 1334.)

when a truck is caught in the mud or ditch, a short angular hitch permitting the horse or horses to pull up and out on the load, will invariably give success; whereas a straight pull, if the traces are horizontal, would not pull the truck out of the mire or ditch.

This question, let it be said, is not as easily solved or answered as might at first seem, for there are several factors which bear on the matter, and these are considered briefly below:

In the first place, we had probably best consider what happens in the case of a short or long hitch when the pairs, traces, ropes or chain used are of different lengths for each pull, but perfectly horizontal during the act of pulling. As the scale in the two figures shown, the pull exerted in this case, 200 pounds, is the same whether the trace is long or short. This may not seem so at first, but it is a proven fact and anyone who has studied engineering calculations, especially those concerning the movement of railroad trains and the power required to move a given load (whether in a car, wagon, automobile or sled) with a certain co-efficient of friction, and knowing the speed at which the mass is to be moved, will see this point immediately.

Regarding the short and long hitch with the horizontal or usual style of traces, it might be interesting to note that the writer before being able t convince a friend of his that the pu is practically the same in either cas (disregarding any small infinitesima loss due to any extra long traces, chain or ropes used and their consequen weight, or any swinging) had to get the opinions of five professors of mechanical engineering in leading American universities (and these letters are still on file for the benefit of any other "Doubting Thomases"), to the effect that this law is correct.

To sum up the situation in a few words then, and providing the traces are straight or horizontal, and not placed on an angle, which changes the effect of the problem at once:—it does not make any difference whether we use a short or long hitch. The same would apply to a man pulling with a rope attached to a piano or other heavy mass, and he would not pull any more—or less, whether he were five feet or twenty-five feet from the load!

Where this problem changes entirely, due to placing the traces at an angle, is shown in the two lower illustrations at Fig. 7. The illustration showing the front wheels of a wagon in a gully, and resting against a large amount of dirt, talks for itself and shows that the only successful or logical way in which to get this wagon out of the rut, is to apply two forces, one *upward* and one *forward*. Calculating the resulting forces accruing from the slanting traces and solving the parallelogram of forces as shown in the drawing, taking the pull exerted in the traces as 200 pounds, we find that the horizontal component or forward pulling force would be 199 pounds, while at the same time an upward or vertical lifting force of 20 pounds would be exerted to help raise the wagon out of the rut or gully.

(*Continued on page* 1338)

FREE for 10 Days' Wear

Send no money—just tell us which ring to send—No. 102 or 103. We will send you one of these genuine sparkling Tifnite gems mounted in solid gold—on 10 days' FREE TRIAL. Don't miss this offer. Send. **Put It Beside a Diamond** When it arrives, deposit $2.50 with postmaster. Wear it 10 days. See how beautiful it is. If anyone can tell it from a diamond, send it back and we refund deposit. If you buy, pay the balance at $3.00 per month until $12.50 is paid. Price complete—terms lowest on record—everything on pre-war basis. Write today. Send strip of paper fitting end to end around finger joint.

The Tifnite Co., 5118 Plymouth Ct., Dept. 1347 Chicago

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP A few hours interesting work saves over half and gives you a machine to suit your ideas. We furnish motors, tone arms, case material, blue prints and full instructions Plays any record. Make fine profit building phonographs for your friends. Write today for our Blue print offer. **FREE AGENTS** wanted for Choraleon King Phonographs

SAVE OVER HALF

Choraleon Phonograph Co. 421 3rd St., Elkhart, Ind.

FREE $20

Violin, Hawaiian Guitar, Ukulele, Guitar, Mandolin, Cornet, Tenor Banjo or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee [illegible]

Make Your Own Violin

from exact reproductions of 12 old masters. Complete plans and specifications, one dollar, postpaid.

Violin Outfits from $15 Up

JOSEF DEULIN Violin Maker and Repairer "Everything for the Fiddle"
1414 Broadway DETROIT, MICH.

MECHANIC'S POCKET SECRETARY 25c

Constructed of finest steel. Just push the button and out comes the article you require. Worth $1.00. Postpaid

10 in 1 Adjustable Pencil, pen, paper knife, ink eraser, pencil sharpener, nail file, and cleaner, mechanic's marking point, fine compass with screw attachment, foot rule.

25c Get One Today

Universal Co., Box A, Stamford, Conn.

Book on Law Free

Write today for our new 171-page book on "The Power of Law Training." It carries a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law trained man. Find out how you can learn from masters of the law right in your own home. No obligations. The book is absolutely FREE. Do it now while we are making a special reduced price offer.

Write Today—special reduced price offer.

American Correspondence School of Law 7444-3601 Michigan Ave., Chicago, Illinois

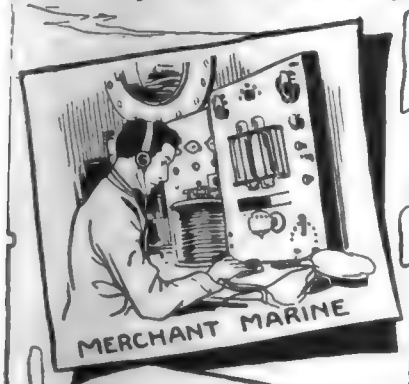
LEARN WATCH REPAIRING

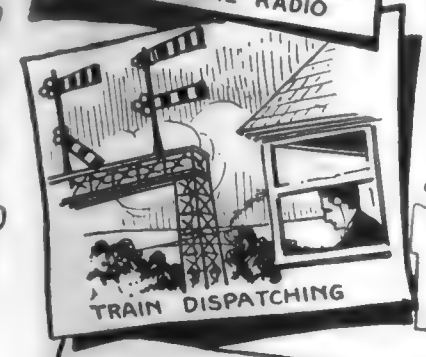
You can learn by our modern and original system of instruction every part of the Watch Repairing Trade at home as good or better than at a shop. You can earn money while learning and secure a well paying position or start in business after completing our course of instruction. Good watch repairers are always in demand and earn from $30 to $65 per week. For particulars apply to the

[illegible] SCHOOL OF WATCH REPAIRING, 160 Nassau St., New York City

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LEARN WIRELESS At Home By Mail





Wireless Operators Employed at Good Salaries by Merchant Marine, Commercial Land Radio Service, Radio Supply Factories, U. S. Navy, Government Service and Aerial Mail.

Salaries Up To $3,500 a Year

Exceptional opportunity for ambitious men for promotion to the higher branches of Radio. Our graduates are qualified as Senior Operators, and besides room and board, receive $125 a month to start, which altogether means more than $200. Positions to which they can promote themselves are as follows: Supercargo and Wireless Operator—$175 a month; Radio Mechanic—$1,500 to $2,000 a year; Radio Aid—$6 to $8 per day; Radio Inspector—$1,500 to $3,000 a year; Radio Engineer—$6,000 and more a year; Radio Draftsman—$7 to $10 a day. You can learn wireless the National Radio Institute way, quickly and easily, by mail right in your own home, in your spare time. No previous experience or training is necessary. With our help you can quickly qualify for first grade government license and a fine position.

U. S. Department of Commerce Recognizes N. R. I.

and allows its graduates 5 to 10 points credit when taking the examination for First Grade Government License. This school heads the printed list of reputable Wireless Schools recommended by the U. S. Shipping Board.

Travel Without Expense

If you are eager to travel, anxious to visit foreign countries and increase your knowledge of world affairs, Wireless offers the chance of a lifetime. On shipboard you are rated as an officer. You need not travel unless you wish, but may secure a position at one of the many increasing land radio offices.

Pay As You Learn

Our plans of payment place a wireless education within the reach of anyone who desires to learn. A small payment down and the small payments made during the course make it possible for you to earn the cost of your tuition while actually learning to be a wireless operator.

New Automatic Wireless Instrument Free

In addition to all necessary text books and other equipment with which we supply you, we furnish FREE to every student our marvelous new automatic Natrometer, which transmits wireless messages in 600 different combinations, and can be regulated to operate at any speed from 1 to 30 words a minute.
It is complete with phones, etc., and is sent you in a neat carrying case. This instrument is operated entirely without the use of aerials and is used exclusively by the National Radio Institute to teach Wireless at home in the scientific way.
You receive the instrument after your enrollment; it becomes your personal property upon completion of our course.

FREE

In addition to our complete course in Radio Telegraphy, every student is given our complete course in modern Radio Telephony. These combined courses enable our students to fill positions requiring a knowledge of both Radio Telegraphy and Telephony. Send the following coupon today for our FREE BOOK containing all particulars.

NATIONAL RADIO INSTITUTE
Dept. 530, 1345 Penna. Ave., N. W.
WASHINGTON, D. C.

Digitized by Google
URBANA-CHAMPAIGN

Free Book

"Success in Music How To Win It"

LET Sousa, Pryor and eight other world-famous musicians tell you secrets of their success; how to discover and cultivate *your* musical "bump"; double your income and pleasure playing in band or orchestra.

FREE TRIAL
Any Instrument

Conn instruments are used by world-famous artists. Known everywhere as *easiest of all to play*. Try any instrument FREE. No obligation, easy payments when you buy. Send coupon for free book and details of free trial plan

C. G. CONN Ltd
456 Conn Bldg. Elkhart, Ind.
Agencies in all large cities

C. G. Conn, Ltd.
456 Conn Bldg., Elkhart, Indiana
Gentlemen:—Please send me "Success in Music" and details of your free trial plan. (Mention instrument.)
Name
Street or Rural Route
City, County
State
Instrument

No Batteries Needed

HAND GENERATED CURRENT
FLASHLIGHT
Gives brilliant light at no operating expense
ELECTRO-AUTOMATE

PRICE
$7.80
Postpaid

Saves cost of batteries and will soon pay for itself. Nothing to get out of order—lasts a life-time. Only a few hundred will be sold at this price—*order at once.* Send check, money-order or cash to

ELSAESSER & WATTS
136 Liberty St. (Dept. 1) New York City

YOU Can Do YOUR Own SOLDERING and All Metal Repairing With

25c

Oddities of Physics

(*Continued from page* 1336)

The solution of the parallelogram of forces is solved by the laws of geometry, viz: the force exerted by the traces, or 200 pounds, is equal to the square root of the sum of the squares of the vertical and horizontal components. Likewise, the value of the horizontal component is equal to the square root of the trace pull, squared, minus the value of the vertical component, also squared; and the value of the vertical component is equivalent to the square root of the trace pull, squared, minus the value of the horizontal component, squared.

It might seem at first glance, after looking over this solution of the short hitch, angular trace problem—that we really obtain more power than was exerted on the traces by the horse, but this is not so, for otherwise we would have *perpetual motion.* What really happens is this:

When the trace is placed at any angle other than horizontal, the horse begins to exert on the load a lifting effect—as well as a forward pulling one, but as the vertical pressure increases, the forward pull decreases in value, until when we have the trace directly vertical, the horse would theoretically be exerting a purely vertical lifting effort, and would exert no forward pulling effect whatever.

Typewriting and Stenographic Machines for the Blind

(*Continued from page* 1282)

produced a typewriter remarkably similar to the original Remington, for making books for the blind.

Some years later, typewriters for everyday use made their appearance, and the names of the American inventors Pratt, Shoales, Soulé, Glidden and Densmore covering the periods from 1864 to 1872 appear on the roll of honor. It is curious to note that the origin was identified with machine-writing for the blind.

Today there are two types of typewriters for the blind, some writing the regular everyday letter and others the Braille alphabet.

The Hall-Braille machine which we illustrate in one of our cuts has had extensive employment in America. It has only six keys, symmetrically placed to right and left, and is arranged with a spacer to separate the words. It will be remembered that we said the Braille letter never needed more than six points, so in the Hall machine with its six keys, all the points required for a letter by one impulse of the operator's hands can be struck at once. With the Hall machine a blind person can write 20 to 30 words a minute, three times the speed of the original typewriting for the blind.

The Frenchman Lotz, the Italian Dr. [illegible]pta, the German Pichl and the Eng[illegible]n, Stainsby, all produce machines [illegible]ix keys, so that a complete Braille [illegible]an be made with one blow.

[illegible]e of our cuts we show the Stainsby [illegible]e, which has been much used in [illegible]d, like the Hall machine in [illegible]a.

[illegible]rds 1910, M. Maurice, Constançon, [illegible]f the Asylum for the Blind in [illegible]ne, Switzerland, produced a dis[illegible] machine illustrated herewith. [illegible] so ingeniously constructed that

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

Dynamo Motor

For Boys

$9.00

For producing current for inductance coils, recharging storage batteries, electro-plating and hundreds of other uses. Well constructed throughout, exceptionally smooth running and highly efficient. A good, strong, durable dynamo that runs as well as a motor without change.

AT ALL LIVE DEALERS

Insist on your dealer showing you the KNAPP line—KNAPP goods are best. If your dealer cannot supply you, order direct. Send for FREE illustrated catalogue showing a complete line of Electrical Motors and Novelties.

KNAPP ELECTRIC & NOVELTY CO.
523 West 51st Street, N. Y. City

Box like a Champion!

Do you want to outbox the best man in your crowd, no matter how big or strong he is?

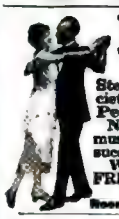
You can do it all right. Marshall Stillman teaches you by mail, right in your own home. You learn how in five simple lessons. A few weeks' practice makes you lead, guard, hit, duck and feint like an expert professional. Also how to defend yourself against all sorts of violent attack.

Don't believe it? We take the risk. We send you the Course free on approval. If you like it you pay for it the 15th of next month—$5 in U. S., $6 in Canada, $7 in other countries. If you don't like it you return the Course in 10 days.

Write today. Give name and address clearly.

MARSHALL STILLMAN ASSOCIATION
Suite E204 461 Fourth Ave., New York

"Lighting Fixtures"
Ready to Hang
(Direct from Manufacturers)
Completely wired, including glassware. New designs.
Send for catalog No. 20
ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.



Learn to Dance

You can learn Fox-Trot, One-Step, Two-Step, Waltz and latest "up-to-the-minute" society dances in your own home by the wonderful Peak System of Mail Instruction.

New Diagram Method. Easily learned; no music needed; thousands taught successfully; success absolutely guaranteed.

Write for Special Terms. Send today for FREE information and surprisingly low offer.

WILLIAM CHANDLER PEAK, M. S.
Room 244 4737 Broadway, Chicago, Ill.

ALL MAKES

Underwoods, Monarchs, Remingtons, L. C. Smiths, Olivers, Royals, Coronas AT REDUCED PRICES. Prices as low as.... $20.00

Write for our Catalog No. 15

BERAN TYPEWRITER CO.
Dept. 21, 58 W. Washington Street, Chicago

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

both sides of the paper can be used. It must be remembered that the letters are read by the points in relief,—the arrangement of this machine is such, that the relief points on one side of the paper occupy the blank spaces of paper between the relief points on the other side. Of course with this machine exact registration is absolutely essential. Again we have the six keys arranged radially for making the Braille embossments. Like all the machines hitherto mentioned, this Constançon machine is deficient in speed.

We now come to a stenographic machine. M. Pierre Villey, the eminent professor of the University of Caen, France, blind from infancy, invented a stenographic machine for the blind, and in spite of the war, managed to complete its construction by October, 1916. It uses syllabic signs and adhering to the Braille embost points, the inventor developt a most ingenious phonography of his own. It is fair to say that the development of his stenographic system to be written in points, was as much an invention as the machine which executes it. Twelve points in his system can be combined in over 4,000 ways, giving an immense number of syllables; three lines are used for the development of each normal line of writing. What is called the tactile field of the finger is not called upon to go outside of the area of the six Braille points. He has even developed the embossing to such an extent that the blind person can read simultaneously with both hands.

A blind stenographer has reached the remarkable speed of 140 words a minute with this machine. It is to be noted that he was an exceptionally expert operator. Our illustration shows the general arrangement of the parts and it will be seen that it prints upon a wide band of paper.

Finally Lieut. Muller, an officer of distinction who was wounded in the war, and blinded there, has produced what he calls his stenoglyphe, also in the year 1916. He uses a phonetic stenograph alphabet in which each sign represents a syllable. He adheres to the Braille embossments. He uses ten points. One feature of his system which is favorably commented on, is that while its rapidity of execution is quite sufficient, it gives a text very easy to read. It was thought at one time that the ten points covered too much of an area, but it is found that it can be read with as great a rapidity as any other system.

FIREFLIES' LIGHT IS MOST EFFICIENT.

Fireflies which will soon be flashing in parks and gardens are called by Dr. E. Newton Harvey, professor of physiology, Princeton University, "a most extraordinary kind of lamp which is able to make its oil from the products of its own combustion." Speaking before the American Philosophical Society, he described the chemistry of the production of light by the firefly. Without going into technical details, it may be said that this light is due to the burning or oxidation of a substance called luciferin in the presence of an enzyme or catalyst called luciferase. As in other methods of burning, oxygen is necessary; unlike other methods, water is essential, and no carbon dioxid or heat is produced.

When the luciferin is oxidized, producing light, it turns to oxyluciferin and water. The strangest part of this reaction is that it reverses itself immediately, the oxyluciferin and water forming luciferin. "Thus, while a firefly is flashing, oxyluciferin is produced, and between the flashes oxyluciferin is reduced and is now ready to be again oxidized with light production."

This reversible reaction can be produced in a test tube by any one who can collect the luciferin and luciferase.

Learn Mechanical Drawing

Men Needed

Salaries: $35 to $100 per Week

I personally stand back of the Columbia School of Drafting—founded, directed and owned by myself—and guarantee the training given by it to be absolutely as represented. The work of each one of our students has my personal supervision. We seek "Quality" students rather than "quantity," as our proposition is of the highest character in every respect.

Roy C. Claflin
President

Are you earning less than $35 a week? Can you reasonably expect your present position to pay you $35 to $100 a week in the near future? If not, this offer will interest you. We offer to qualify you for a profession which, at the very start, pays higher salaries than the average man receives. We offer you the best personal service obtainable. We offer you personal instruction in mechanical drawing and teach you expert Draftsmanship in your spare time, at your home, by mail, in the same practical way that you would learn it in any big Drafting department. We offer to qualify you for one of the many high-salaried positions in the Drafting field, and to keep you in touch with openings for Draftsman in big machine shops, industrial plants, manufacturing concerns and United States Government Departments. We guarantee to start you on real Drafting work at once qualifying you as a thoroughly trained professional Draftsman, capable of succeeding from the very start. One of the many outstanding features of our training is that it qualifies you in an unusually short time.

Become a Chief Draftsman

You cannot make a mistake by taking up mechanical drawing. The field is not crowded, nor can it be. No single profession today offers better opportunities. The great need for trained Draftsmen continues to increase. Each step forward in mechanical development creates a need for more trained Draftsmen. Promotion in this field is sure and certain. Men who start as Draftsmen are often advanced to Chief Draftsmen, Chief Engineer, Production Manager or other high-salaried positions. There is a constant demand for our graduates. We cannot supply them rapidly enough. Many of them are accepted even before they complete their training. This unusual demand for "Columbia" Trained Men is explained by the fact that our students enter upon actual drawing work the day they receive their first lesson. They spend no time with unnecessary preparation or useless theory.

The Largest Institution Specializing in the Training of Draftsmen. Teaches You Mechanical Drawing at Your Home.

This is the mechanical age in world history. The day of big opportunities for technically trained men is here. Especially is this true in the case of Draftsmen, on whom the mechanical industries of America and the entire world depend. On no one profession does the continued development of machinery so nearly center. With the training which we can give you at your home, your services will always be in demand, at a premium, in this permanent, highly paid field.

Drawing Instruments Furnished

We supply our students with complete drawing equipment. A professional outfit is furnished, together with a highest grade set of Drafting instruments for your permanent use.

No Previous Training Necessary

As our students are put into actual practice at the beginning, they grasp the essentials of drawing quickly. The lessons supplied are thorough, clear and easily understood even by those who have had no previous technical training of any kind. No previous experience or special education is necessary.

COLUMBIA SCHOOL of DRAFTING
Roy C. Claflin, *President*
Dept. 1406, 14th and T Streets
WASHINGTON, D. C.

Send in the Coupon Today

It Brings to You full particulars of our proposition. Your future depends upon what you do now. We cannot begin to tell you here, in so few words, of the advantages afforded you by this unusually practical course in up-to-date mechanical drawing. If you are in earnest and desire to learn a big-paying profession, we urge you to act now by returning the following coupon. We will immediately send you our book of information, "Your Future in Drafting," which tells of our new method of teaching mechanical drawing and outlines our offer to you fully.

SEND THIS COUPON TODAY

COLUMBIA SCHOOL of DRAFTING
Dept. 1406, 14th and T Sts., WASHINGTON, D. C.

Without obligation to me, please send me your illustrated book on Drafting, telling how I can secure your complete home study course and your help in securing a position as Draftsman.

Name.....Age.....
Address.....
City.....State.....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

This Man Wouldn't Stay Down

He was putting in long hours at unskilled work. His small pay scarcely lasted from week to week.

He saw other men promoted. Then he learned the *reason*. They had special training. He made up his mind to get that kind of training.

He sent to Scranton a coupon like the one below. That was his first step upward.

The reward was not long coming—an increase in salary. Then he was made Foreman. Now he is Superintendent.

It just shows what a man with ambition can do!

What about you? You don't *have* to stay down. You *can* climb to the position you want in the work you like best.

The way to do it is easy—without obligating yourself in any way, mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6187-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	Pharmacy
Electric Wiring	SALESMANSHIP
Electric Lighting	ADVERTISING MAN
Electric Car Running	Window Trimmer
Heavy Electric Traction	Show Card and Sign Paint'g
Electrical Draftsman	RAILROAD POSITIONS
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	Business Correspondent
Ship Draftsman	BOOKKEEPER
Machine Shop Practice	Stenographer and Typist
Toolmaker	Cert. Pub. Accountant
Gas Engineer	Traffic Management
CIVIL ENGINEER	Commercial Law
Surveying and Mapping	GOOD ENGLISH
MINE FOREM'N OR ENG'R	STATIONARY ENGINEER
ARCHITECT	CIVIL SERVICE
Architectural Draftsman	Railway Mail Clerk
PLUMBING AND HEATING	Textile Overseer or Supt.
Sheet Metal Worker	AGRICULTURE
Navigator	Poultry Raising ☐ Spanish
	Automobiles ☐ Banking

Name_____ 1-1-21

Present Occupation_____ Business Address_____

Street and No._____

City_____ State_____

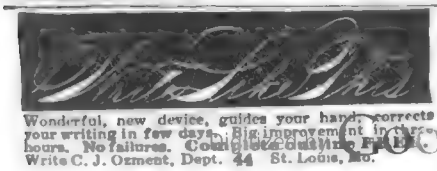
Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada

Make $100 a Week

GO INTO BUSINESS FOR YOURSELF

Retail Rawleigh Good Health Products. Toilet Preparations, Spices, Flavors, Cocoa, Dessert Powder, Household Medicines, etc. 130 useful items needed in every home every day. On market 30 years—used by millions. Your relatives, friends and acquaintances will buy at sight—become regular customers. Easy to build permanent, profitable, big paying business. Pleasant, healthful, outdoor work. Make $3000 to $5000 a year, or more. Experience or capital not necessary. We furnish free advertising matter and sale helps. Write for particulars.

THE W. T. RAWLEIGH CO.
861 Liberty St., Freeport, Ill.



Wonderful, new device, guides your hand, corrects your writing in few days. Big improvement in few hours. No failures. Complete outfit sent FREE. Write C. J. Ozment, Dept. 44 St. Louis, Mo.

200 Miles per hr. Air Propelled Railway

(*Continued from page* 1279)

major part of the load or weight, the car units resting on ball-bearing wheels so as to minimize all friction.

The car units as devised by the inventor, are intended to be made up in short, inter-locking sections, the coupling between each unit being flexible to a certain degree so as to facilitate the train of several sections moving thru curved tubes at high velocity.

Mr. Barlow has called the front section, the "engine unit," and this contains the electric motors and the propellers which create the rearward thrust on the air and on the side walls of the tube, which walls are formed into annular pockets with curved tails, the air taking the course indicated by the arrows. The tube is designed to be about 9 feet in diameter, while the body of the train and the engine units are much smaller so as to provide plenty of space for the air currents and propeller action.

Mr. Barlow has had considerable experience in flying large airplanes and it was due to this experience, that he was imprest with the idea of designing a new transportation carrier embodying the principles here elucidated. The reason for using three propellers is based on the fact that a smoother action is obtained in creating such a high velocity thrust on the air. Each of the three propellers rotates at the same speed, but they are arranged with successively increasing pitch so that the air current from front to rear is smoothly but rapidly accelerated to a very high velocity.

One of the principal points covered in his patent on this railway, and as explained to the editors, is the arrangement of the inner wall of the tube or duct so as to quickly bring to rest the rapidly moving air currents set up by the propellers mounted at the forward end of the car or train. If this were not done, a powerful current of air would be created which would continue rearwardly from the train for a great distance, and would eventually interfere with the progress of any train or car units which might be following close upon the leading train.

The inventor explained that by this method of curving the rear edge of each wall pocket around toward the front, any current of air thrown into it by the propellers, would swirl around and be shot out in a forward direction eventually, so as to react against the sides of the train,—as well as forming a reaction jet or wall for a part of the rearwardly current of air from the propellers, and thus give greater speed to the onward rushing train.

By this arrangement of the operating factors, it will be seen that all which will result in the rear of the train, would be a series of air eddies or practically local swirls of air.

Another one of the important merits of this system, as compared to an airplane flying in free air, is that none of the power used in propelling the train *is required for sustaining the load*, as is the case with the former machine.

The inventor also points out that the provision of the enclosing tube insures a continuous solid and stable condition of the air on which the propeller operates, and it is interesting to note that contrary to most systems proposed along these lines, the tube does not have to be air-tight. In fact when there are conditions where ex-

Make Your Own Selenium Cells

Complete Selenium Cell Outfit

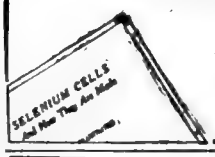
Just the Thing for the Experimenter

A complete selenium cell outfit shipped in metal carton, including fully illustrated book on selenium cells entitled, "Selenium Cells and How They Are Made," by Samuel Wein (the only book of its kind on the market), together with a piece of selenium, a slate slab and sufficient wire to make a selenium cell.

This book contains a very valued analysis of selenium, giving such information as to its discovery, its source and manufacture for commercial uses, its chemical characteristics and an instructive talk on the various cells in which it is used. Intelligently written in very plain language.

Only a limited supply of these books on hand.

$2.00 COMPLETE Postage Prepaid



Order today

The Steen-Bleyer Chemical Company
1807 Candler Building
220 West 42nd Street
New York City

The Boys' Magazine FREE!

Send us the names and addresses of 10 boys (from 10 to 16 years old) and we'll send you a copy of this splendid magazine FREE. Great stories—beautiful illustrations—handsome covers in colors. Departments devoted to Wireless, Electricity, Mechanics, Athletics and Physical Training, Moving Picture Plays and Players, Cartoons and Jokes. (Write plainly.)

Address

THE SCOTT F. REDFIELD CO.
6028 Main St., Smethport, Pa.

THE BOYS' MAGAZINE on sale at all newsstands, 15c a copy

1/4 H. P. MOTORS

110 volts, A. C., 60 cycle, single phase, 1750 R. P. M.

LARGE QUANTITIES NEW WASHING MACHINE MOTORS

These are of standard manufacture and carry the full factory guarantee. Shipped in original boxes. Complete as cut. Suitable for operating Coffee Grinders, Cream Separators, Bottle Washers, Air Compressors, Sewing Machines, Etc.

Send U.S. Funds or Money order or we will send C.O.D. subject to full examination. Money back if dissatisfied.

Quantity limited. Order at once. Write for Bargain Bulletin No. 21 describing other Motors and Generators.

MANUFACTURER'S DISTRIBUTOR'S WAREHOUSE

$22.75 EACH

CHAS. B. JOHNSTON - Box 12 N. E. Pittsburgh, Pa.

LEARN ENGINEERING

Electrical and Mechanical Engineers receive fabulous salaries. Thousands wanted. 3 months to 2 years Practical-Technical training under experts. Not a trade school but a Practical-Technical College teaching electricity, steam, gas, auto-electric, armature winding, drafting. Extensive laboratory and shop equipment. Degrees awarded. Day and night sessions. Enroll any time. Don't judge us by size of ad. Write for free catalog. FINLAY ENGINEERING COLLEGE, 1003 Indiana Avenue, Kansas City, Mo.

PROTECT GOOD TOOLS

UNION Tool Chests

Good tools deserve a Union chest. Styles and sizes for all mechanics. Quartered Oak, Plain Oak and Covered. Write for catalog and prices.

UNION TOOL CHEST CO., Inc.
36 Mill St., Rochester N.Y.

You can be quickly cured, if you

STAMMER

Send 10 cents for 288-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering 20 years. B. N. Bogue, 147 N. Ill. St., Indianapolis.

Digitized by Google
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

tremely high speed is not desired, it need not be covered at all.

It would seem that the high speed claimed by the inventor, as attained by this novel form of railway, propelled by air screws in contra-distinction to the usual form of railway car propelled by an engine or electric motor geared direct to the wheels,—is due to the fact that with the standard form of railway, the total tractive effort—which directly concerns the speed and power with which the car is moving,—is dependent upon the great weight of the car upon the wheels.

In other words, the steam locomotive which has the largest weight directly over the driving wheels,—other things being equal, such as good design, etc.,—will exert the maximum tractive effort. Further it seems that Mr. Barlow gets around this defect by decreasing the weight on the bearing wheels in order to realize high speed and propelling power by utilizing the air screw as employed in the airplane.

The traction of a locomotive engine depends on its weight, giving adherence to the wheels, but of course an airplane has no such requirements, the lighter it is the better, and in the Barlow air-screw engine, the weight has nothing to do with its tractive power.

At this point it might be well to mention, as a matter of actual fact, that no railway carrier in which motors or other prime movers are geared directly to the wheels, have ever attained a speed in excess of 130 miles per hour (Berlin-Zossen tests)—but, as we know, airplanes have reached a speed closely approaching 200 miles per hour in the past year, in several instances,—and a speed of 150 to 160 miles an hour has been attained several times by the standard type, medium powered, U. S. Government mail planes.

Mr. Barlow prefers to drive his propellers with a series of eight small electric motors, geared in any suitable manner, in preference to one large electric motor, for the simple reason that the small motors can operate at high speed much more efficiently and safely than a large one. All the construction and operating features of such an air-propelled railway are we believe, quite clear now, and these features present mostly details to be worked out by construction engineers.

COMMERCIAL ASPECTS OF THE AERIAL PROPELLED RAILWAY.

The commercial features of this air-propelled railway devised by Mr. Barlow, are surprising and revolutionary in the extreme. As pointed out by Mr. Barlow in an interview, the inventor's great dream is to see railways of this type built over great stretches of country so as to serve not only sections of great cities or suburban sections thereof, but to act as automatic high speed carriers of everyday mail, grain, oil, etc., between various parts of the country,—such as between the lake-ports of the North and the gulf-ports of the South.

One of the detailed drawings in the illustration herewith shows one of the unique features of the Barlow aerial railway, namely, the automatic switching arrangement and the device whereby the cars can be routed at their originating stations so as to distribute themselves to the proper destination, without the aid of any human agency. A code box with a series of levers projecting for each of the different stations along the route, which route may be several hundred miles in length or more, is fastened to the forward end of each train.

As will be evident, if the index trip is pulled out corresponding to St. Louis, for example,—and a car is started at Chicago

Quick Success in Electricity!

Get Ready to Make Big Money

Thousands of Electrical Experts Needed

Electricity is King. No other industry in the world offers the wonderful chances for big money and quick success that the Electrical Industry offers to ambitious men today. Trained Electrical Experts are needed to fill big paying jobs. This is truly the electrical age—electricity is rapidly taking the place of steam and hand power. Thomas A. Edison says Electricity is still in its infancy. So get into it now. Those who get in now are the ones who will cash in big.

A. W. WICKS
Elec. Engineer

My extensive electrical experience has been gained with such important industrial concerns as General Electric Company, Jeffrey Electric Co., Fairbanks, Morse & Company, also as Advisory Engineer for such mammoth companies as Corn Products Co., Quaker Oats Co., and the Corporation Steel Plants.

To $150 a Week and More

Go as high as you like. No limit to salaries in Electricity. In the Electrical Industry it is not a question of pay, it's a question of trained men—electrical experts are needed to fill big jobs as Power Plant Superintendent, Chief Electrician, Sub-station Operator, Electrical Inspector and hundreds of other positions. Electrical Contractors also make big money. There is also big money in conducting Electrical stores.

FREE

Here are some things I give and do for my students Absolutely FREE.

1.—Complete and Valuable Electrical Tools, Instruments and Equipment.
2.—Monthly Bulletin of interesting facts and news of what's doing in Electricity.
3.—Practical Training in Electrical Draftsmanship and Blue Print Reading.
4.—Prepay charges on everything I send you.
5.—An indispensable Electrical Dictionary.
6.—Full benefits of my Employment Service.
7.—Complete supply of Examination Paper, Envelopes and Stationery.

Space does not permit me to detail the scores of other things I do for my students Absolutely Free.

Learn at Home I Teach You MYSELF

I am an authorized Electrical Engineer. Every student is under my personal instruction assisted by an advisory staff of prominent Engineers and Electrical Manufacturers. The Wicks Electrical Institute is known nationally as the largest and foremost school giving home training in Electricity, and its policies and methods are highly endorsed by the Electrical Industry. Its system of instruction is positively "Best by Test," for its graduates make good.

BIG BOOK of Opportunities FREE

Let me send you this big book of opportunities with my compliments. There is no obligation. Find out for yourself what is doing in the Electrical Industry. You owe it to yourself to investigate. This book shows what other ambitious men have done in this field and what you can do. With this wonderful book I'll also send you a complete outline of my method of instruction and actual letters from my students and graduates testifying to what my training has done for them.

Save $43.00 Tuition Now

SEND COUPON TODAY—DON'T DELAY Those writing now will save $43.00

This offer is special and is made for a limited time. So mail coupon at once. This is the most unusual offer ever made to ambitious men. So hurry.

A. W. Wicks, E. E., Pres., WICKS ELECTRICAL INSTITUTE
3601 Michigan Avenue, Dept. 2994, Chicago, Ill.

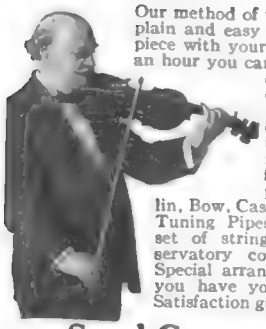
FREE COUPON

A. W. Wicks, E. E., Pres., WICKS ELECTRICAL INSTITUTE
3601 Michigan Avenue, Dept. 2994, Chicago, Ill.
Without any obligation send me your Big New Book, "Opportunities in the Electrical Field," and full particulars regarding your method of training.

Name.....
Address.....
City..... State.....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Learn to Play the Violin IN YOUR OWN HOME



Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it. Complete course under personal direction of Prof. A. Hinchcliffe, a musical director and violin teacher of prominence for the past forty years. Low price includes Violin, Bow, Case, Chin Rest, Rosin, Tuning Pipes for all strings, extra set of strings, and complete conservatory course of instruction. Special arrangement for lessons if you have your own instrument. Satisfaction guaranteed.

Send Coupon NOW
Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.
233 Broadway NEW YORK

I am interested in the VIOLIN. Please send complete information, special offer, etc.

Name.....

Address.....

S. & I.-V.

Town and State.....

Write Name and Address Clearly

6000 Mile Guarantee

Clifton Double Tread Tires are noted for their long wearing qualities. **All are standard makes** reconstructed in our own factory by experts. 6,000 mile guarantee. These wonderfully long wearing tires must go at

FREE TUBE and RELINER

SMASHED PRICES

30x3	$ 6.90	34x4	$11.10
30x3½	7.95	34x4½	12.25
32x3½	8.75	35x4½	12.75
31x4	9.85	36x4½	13.25
32x4	10.35	35x5	14.00
33x4	10.80	37x5	14.25

Free Tube & Reliner

State size wanted S. S. or Cl. Non-Skid or plain tread. Send only $2.00 deposit, balance C. O. D. subject to examination. **Satisfaction Guaranteed. Order To-day — Supply Limited.** 5% discount if cash is sent with order.

CLIFTON TIRE CO.
3536 Ogden Ave. Dept. 44A, CHICAGO, ILL.

BE A REAL MAN!

LOOK LIKE ONE AND FEEL LIKE ONE

Broaden your shoulders, deepen your chest, enlarge your arms, and get a development that will attract attention. Fill yourself full of energy and be powerful.

My New Book
"Muscular Development"
Will Explain How

This book is illustrated with 25 full page photographs of myself and of some of the world's finest developed athletes I have trained. It will interest and benefit you greatly.

Send 10c (stamps or coin) for a copy NOW, today, while it is on your mind.

EARL LIEDERMAN, Dept. 204, 305 Broadway NEW YORK CITY

Big Band Catalog sent free

Whatever you need—from a drumstick to the highest priced cornets in the world. Used by the Army and Navy. Send for big catalog; liberally illustrated, fully descriptive. Mention what instrument interests you. Free trial. Easy payments. Sold by leading music stores everywhere.

LYON & HEALY
63-96 Jackson Blvd. Chicago

HOME STUDY - SPECIAL RATES
Normal, Grammar School, High School, Civil Service, Engineering, Agricultural, English, Bookkeeping, Shorthand, Typewriting, Journalism, Bible, Salesmanship, and Law Courses thoroughly taught by mail. For Special Rates, apply
CARNEGIE COLLEGE, ROGERS, OHIO

with this trip properly arranged, the car will hit the St. Louis "trip" when it reaches that city, causing the track to be switched over a considerable distance ahead of the swiftly moving car, and it will be shunted into the St. Louis tube. As seen, when the car passes into the St. Louis tube, it hits a second trip which causes the main line switch section to be quickly moved back into junction with the main line tube. A flexible section of tube can be used for this switching purpose, as one of the diagrams clearly shows. This is a detail which can be solved, of course, in several different ways.

The beauty of Mr. Barlow's idea which appeals to our minds in both a commercial and utilitarian sense, is the automatic distribution of great quantities of grain, oil, and other miscellaneous products, to shipping ports and municipal distribution centers at a heretofore undreamt of speed. The cars in this system can be operated all day and all night, and follow one another at intervals of one-half to one mile, the distance between them being regulated, if necessary, by automatic electrical block systems.

The cars need never stop,—even to discharge their cargoes, an automatic trip system being arranged at the receiving warehouse, whereby the grain for example can be dumped from the compartments as the car moves at a reduced rate thru the graineries, the grain being readily discharged thru pipes directly into the holds of steamships, which would thus distribute the grain to all parts of the world almost automatically from the time the wheat was growing until it was received by the consumer.

Undoubtedly it will be found advisable to adapt a system of signals to be placed in the master dispatcher's office of his high speed railway, which would indicate instantly at a moment's notice, just what carriers were in the tubes and their exact location, similar to the visual signal boards used at the Panama Canal, and also in the Hudson Tube Railway system which passes under the Hudson River from New York to New Jersey.

What to Invent

By JAY G. HOBSON

(*Continued from page* 1320)

Still, right now I would be mighty thankful if the S. & U. R. R. had a SANDWICH SLOT MACHINE somewhere in its anatomy, and from the look upon the faces of the other early birds stretched around me, who didn't get their worm either, I'll wager ten to one, there wouldn't be many sandwiches left, at any price, if there was only a sandwich slot machine where we unfortunates could push our coins into it. So if this condition is true with us today, why isn't the idea for a sandwich slot machine for trains, and pubfic places as practical as chewing gum slot machines? I am sure it is, and also believe slot machines for dispensing food in such places would make lots of money for the inventor and those placing them there.

WATER PURIFIER FOR LIFE BOATS.

I have in mind a possible filter of improved design, made so sea water could be poured into it and purified for drinking purposes. A filter construction with the purifying element of silver citrate or some other substance that would decompose the saline contents of sea water, and make it suitable for drinking when wrecked at sea. One of these filters would be included as standard equipment on each life-boat.

(Copyright by Jay G. Hobson, 1921.)

Klim Mattress $10.95 and Express on Arrival

Large Size

Send No Money

Famous FELT Mattress
At a Rare Bargain

Just send your name and address—no money—and we'll send you a genuine first quality Klim Mattress. All you need to do is pay expressman the special low introductory bargain price of $10.95, and express, on arrival. You take no risk—money back promptly if not satisfied.

ENJOY REAL COMFORT

Never before has it been possible for us to offer this famous 50 pound, high quality, long wearing, all felt mattress at such an amazing price. Made of pure white layer felt covered with best quality blue and white striped ticking. This is the mattress for a lifetime of wear.

Order NOW at Bargain Price!

Send your order today—no money down. If dissatisfied, return to us and we pay charges both ways. Be sure to state whether 42, 45 or 54 inch width. Order now. Supply limited.

HOUSE OF ANTON KLIMEK & SONS
1257 Noble St., Dept. 105 Chicago

Price $1.50

Foreign $1.60

SCIENCE PRODUCED IT

The THERAPHONE Mouthpiece puts your message across CLEAR. Gets attention—holds it—makes friends. No repeating or confusion. Unequalled for privacy, range and perfect phone service. Affixed in a minute. Endorsed by users everywhere. Check or C.O.D. Satisfaction guaranteed.

THE EVOLUTION PHONE COMPANY, Inc.
48-CM Greenwich Avenue New York City

$4 AND $5 WILL BUY
A Standard, Guaranteed TYPEWRITER
With Every Modern Writing Convenience

WRITE TODAY FOR ILLUSTRATED CIRCULAR Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

MUSIC TAUGHT FREE

You can read Music like this quickly

In Your Home. Write today for our booklet. It tells how to learn to play Piano, Organ, Violin, Mandolin, Guitar, Banjo, etc. Beginners or advanced pupils.
American School of Music, 57 Lakeside Bldg., Chicago

Handwriting Tells You Secrets

Be successful. Find out what holds you back. Send us an ink specimen of your handwriting and $1.00. Our expert Graphologists will tell you your faults, virtues, talents, etc. Your $1.00 back if you are not satisfied.

ROBERT R. ROSS, 110 West 40th St., N. Y.

STAMMER NO MORE

Kill the fear of stammering. Re-education the key. The widely famed Hatfield Method fully outlined in an accurate, dependable, worthwhile book—"HOW TO STOP STAMMERING." It has inspired thousands. Order a copy today. THE HATFIELD INSTITUTE, 109 N. Dearborn, Chicago, Illinois

"FIBRE-LITE" LIMBS

Easy Payments—Do Nature's Work. AGENTS WANTED who wear leg. Good Pay. FREE Fibre Sample.
Describe Stump to
WORMAN CO., 252-D HENNEPIN, Minneapolis, Minn.

PIGEONS PAY Easy raised, use small building, very little space required. Build their own nests, feed their own young. Very profitable business. Get your start with a few good pairs. Write today for Free Circular.
Pigeon Supply House, Hanover, Pa.

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff., 15c; 1000 all diff., fine collection in itself, $5.00; 100 diff U. S. 30c; 1000 hinges, 10c. Agents wanted, 50% commission. List free. I BUY STAMPS.
L. B. DOVER LONGMONT, COLO.

Digitized by Google
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Electric Power from the Air

(*Continued from page* 1280)

urements obtained, in a number of works which may be consulted at the local library.

The atmospheric charge is usually gathered on a metal ball fastened to a rod, to the other end of which rod is connected an electro-static voltmeter in a suitable casing. Measurements have been made with this apparatus during the changing seasons of the year; the apparatus has been established in a laboratory on the ground as well as in a balloon which was sent aloft.

Dr. Plauson therefore proposes in his latest scheme for utilizing the electrical energy collected in the atmosphere, that we send aloft a series of inflated balloons having metal coatings, all of these balloons being connected by means of flexible copper conductors so as to discharge all of the energy they may gather thru a single large conductor to the central power station, as shown in the accompanying illustration.

Several important and extremely interesting points now come up for consideration. One of these is that it would probably be advisable in the first plants that are erected for this purpose, to place them on high elevations such as mountains or hills, as in this way it may prove possible to gather the same quantity of electrical energy with a shorter balloon cable than would be the case with plants situated in valleys. If the balloon cables were guyed, the guy wires would have to be suitably insulated the same as radio antenna masts, so as to prevent the dissipation of energy down thru the guy wires to earth.

Dr. Plauson points out that the balloons should be fitted with a multitude of sharp points in order to enhance their collecting powers for the static electricity of the atmosphere, which, as is well known, always discharges toward or from a point more rapidly than with other form of discharger. He even goes so far as to propose that we shall attempt the ionization of the air in the neighborhood of each balloon by suitably coating or painting the surfaces of the balloons with some radio-active salts,—of radium, of polonium, or of other metals.

Some interesting ideas in this direction were publisht several years ago in this journal,—where the process of producing rain by discharging huge quantities of electrical energy from metal surfaced balloons placed in a highly ionized atmosphere, was described. There the ionization was created by powerful X-rays or by ultra-violet rays.

Another very interesting question, but which does not condemn the scheme necessarily, is as to whether or not the electrical energy would be drawn off continuously (under normal weather conditions) or whether it would be discharged to the central collecting station periodically,—similar to the discharge of static electricity which most of us have probably heard in the receivers of radio telegraph stations; but in any event the main problem which all atmospheric electricity investigators have been confronted with, is the danger of being annihilated or else of having their plants destroyed when electric storms are frequent as in the summer months; when a lightning discharge is of unusual severity, it may pass down the balloon feed wire or cable and destroy the machinery of the plant.

If I Had But Two Dollars In The World I Would Pin Them to The Bottom of This Page!

Because This is Your *ONLY* Opportunity To Order Matysek's

Muscle Control Course for but $2.00

In the future the price will be higher

It is the scientific system of control of all the physical functions. You can cure yourself of any functional disorder. You will be independent of all medicines and drugs which you know cannot bring health and are always debilitating. When physicians fail in getting results they suggest Matysek—the Maker of 100% Men.

A "Body Beautiful" Maker

Thousands of men say this course is the surest and quickest "muscle bulging out" stimulant. A curative system of exercises that produce really athletic men with graceful outlines full of strong personality.

These exercises are the CHIEF SECRET of why I am growing despite my age, each day stronger and better developed as well.

ANTONE MATYSEK

the muscular phenomenon, the man who is offering to place you on the energetic strong man map. When you find your place on this map you will always be full of pep, ambition and joy. You will be a REAL MAN and then will achieve your chief aim!

Course Consists of

Two handsomely finished charts containing twenty-one beautifully produced pictures of myself, many of decidedly larger size than the above specimen, showing every detail as to how to perform the movements with absolute correctness. The instructions are in book form and "straight from the shoulder" such as only an expert who went through the mill himself could ever possibly produce.

Let My Muscle Control Exercises Mold Muscle On You Quickly and Solidly!

Only ten minutes a day, in the privacy of your own room, solves any case. I know that in less than five days your efforts will be realized to a most surprising extent. If you are already training on some good "system" these Muscle Control exercises will force your progress to be 100% faster! If, however, you do not exercise, then for your own sake and own happiness, start building yourself up into a *real man*. Do not merely drag on.

Some Subjects are

How to quickly make respond the inactive bowels, easily correct the rounded shoulders, in no time expel the bothering gas out of the stomach, promptly chase away the staleness of the body, strengthen the nerves and internal organs, easily overcome the bodily abuse, efficiently strengthen the sexual organs, control every muscle of your body, store up energy for feats of strength, also: Complete relaxation and contraction—Effective breathing—the best way to arouse your inactive nerves—creation of better blood circulation—easiest way to increase your chest circumference—the famous shoulder blade control—how to thicken the shoulders—how to learn the art of making your shoulders supple from only three days' practice—development and control of the neck muscles—spreading of the back—depression of the abdominal muscles and wall—control of the pectoralis (chest muscles), the biceps, triceps, thighs, calf and all other muscles—how to train the abdominal regions to be immune from rupture—how to master correct posture—simple yet positive cure for insomnia—how to pose for good pictures—Advantages of perfect co-ordination of muscles and mind through concentration which brings success and all the good things that go with it, and many other vital pointers you needed today, too numerous to mention.

Of Particular Interest to YOU

Every reader of Science and Invention is earnestly requested to purchase this course NOW as the truly wonderful benefits it is bringing thousands of men and women throughout the world has prompted me to sell it at practically no profit so that YOU and every one else may enjoy Life at its Best. The two-dollar price applies to this course for a limited time only. The price will surely be increased in the next advertisement. Send for your copy *today* and start reaping the benefits by return mail.

You Can Well Afford It. Costs But $2.00

I guarantee quick results and absolute satisfaction or money back. Come, Friend, let me help you! I will place you on the real road and show you the main secret that helped me to get what I longed for and now certainly possess. In addition you have the privilege to ask any questions pertaining to your physical training; to these I will gladly reply giving you personal attention. This favor alone is worth the $2.00. Better avail yourself of this splendid offer *right now*, for in the future the charges will be doubled. You will be the envy of your friends. Learn how to get the most out of yourself. It is easy and YOU CAN DO IT! GET STARTED RIGHT—RIGHT NOW! Simply tear off the coupon below, mail with but $2.00 (Canadian and Foreign orders—$2.20) and leave the rest to me.

Prof. Matysek

Muscle Control Dept. 401, 523 N. Charles St., Baltimore, Md.

Detach and mail NOW while it is on your mind.
PROF. MATYSEK, Muscle Control Dept. 401.
523 N. Charles Street, Baltimore, Md.

I want bulging muscles and yet I want them to have fine outlines. I desire to increase my strength, my internal activity, my energy, my manly powers. I want to be more than I am now and I want to achieve my "chief aim" in a short and efficient manner. For these reasons send me your wonderful Muscle Control Course, illustrated with 21 high grade pictures of yourself. If I am not completely satisfied, my money will be promptly refunded if course is returned within 48 hours.

Name.....

Address.....

City.....State.....S&I 4-21

PUBLISHER'S NOTICE — The above statements are guaranteed to be entirely truthful.

Digitized by Google
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

LEARN WIRELESS AT HOME

The Demand for Good Wireless Operators far Exceeds the Supply

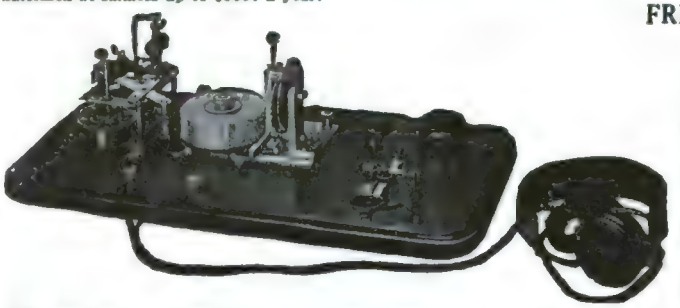
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Mr. L. R. Krumm, formerly Chief Radio Inspector, Bureau of Navigation, N. Y. He resigned last August to accept a position of still greater responsibility with one of the largest Commercial Radio Corporations in the United States. Radio experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way will direct your entire Course. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



FREE Instruments and Text Books

We furnish free to all students, during the Course, *the wonderful receiving and sending set exactly as shown in the illustration.* **This set is not loaned, but given to all students completing the Course. One cell of dry battery all that is required. No additional wiring, aerials, etc., needed.**

This wonderful Set for learning the Code furnished free with our Course.

The Transmitter shown is the celebrated **Omnigraph** used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the **Omnigraph,** place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the **Omnigraph**—the same model **Omnigraph** as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire at one of the largest Wireless Schools in New York City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

The Department of Commerce of the U. S. Government

recognizing the value of the instruction furnished by us, allows all of our graduates a five-point credit in their examination for first-grade license. **THE U. S. SHIPPING BOARD** will also testify as to the value of this instruction.

Wireless Telephony Course

We have incorporated in our Institute an up-to-date and complete Course in Wireless Telephony, written by our Chief Instructor, Mr. L. R. Krumm. **This Course is also furnished free.**

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

AMERICA'S FASTEST GROWING WIRELESS INSTITUTE

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—**but do it today.**

NEW YORK WIRELESS INSTITUTE,
Dept. 212, 258 Broadway New York City

There Must Be a Good Reason.

There Is—

The Best Course in Theory available.

The Best Instruments obtainable.

The Best Text Books and Diagrams on the market.

NEW YORK WIRELESS INSTITUTE
Dept. 212, 258 Broadway, N. Y. City.
Send me, free of charge, your booklet "How to Become an Expert Wireless Operator", containing full particulars of your Course, including your **Free Instrument offer.**

Name.....

Address.....

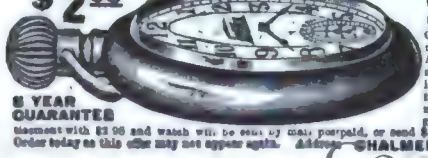
City or Town.....State.....

JUST WHAT YOU WANT ON SEA FARM OR RANCH — OVER 2½ FEET LONG — ONLY 99 CENTS

ACHROMATIC TELESCOPE MADE UPON NEW SCIENTIFIC PRINCIPLES.

Positively such a good Telescope was never sold for this price before. Eastern Telescopes are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 8 inches and open over 2½ feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. Guaranteed by the maker. Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful. A Telescope will aid you in taking views. Objects are brought to view with astonishing clearness. Sent by mail or express, safely packed, prepaid, for only 99 cents. Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. We warrant each telescope just as represented or money refunded. Send 99 cents today. To dealers 6 for Four Dollars.

EASTERN NOVELTY CO., DEPT. 67, 172 E. 93d STREET, NEW YORK.



SAMPLE WATCH FREE

Genuine full standard size railroad style watch with locomotive on dial and locomotive handsomely engraved on back. Full nickel plated case, extra dust proof, Arabic numerals on dial, heavy R. R. style figures. Genuine American make, stem wind and set, fully **GUARANTEED for 5 YEARS.** To advertise our business and introduce this wonderful watch and our great catalogue of Elgin, Waltham and Hampden watches we will send this elegant watch to any address by mail postpaid for **ONLY $2.98** and if you sell two of these watches we will give you **ONE SAMPLE WATCH FREE** for your trouble. Send this advertisement with $2.98 and watch will be sent by mail, postpaid, or send $5.96 for two and we will send **ONE EXTRA WATCH FREE.** Order today as this offer may not appear again. Address **CHALMERS WATCH CO., 538 So. Dearborn St., CHICAGO, ILL.**

The diagram shown in the accompanying illustration is given merely as a suggestion of what we may expect in the direction of atmospheric power plants. Needless to say, the first and foremost mechanism we will have to design will be a suitable and absolutely certain lightning protector, and which is indicated in the present diagram by the ball spark gap. Practically all radio apparatus, at least the commercial types, are fitted with suitable micrometer spark gaps, so that if lightning or extra heavy static charges may pass down the antenna to earth, this energy will be able to leap the gap and thus prevent burning out of the apparatus.

Ordinarily, the atmospheric electric currents will pass down the balloon feed cable and thence thru the transformer primary winding down to earth, at the same time energizing or inducing electric currents in the secondary of the transformer, and from which the successive quotas of electrical energy may be stored in suitable accumulators (of the condenser or other type). The energy stored in the accumulators can then be drawn off as desired and distributed thru a transformer and transmission line. At the receiving end of the line possibly 100 to 200 miles away or more, the line current can be reduced by a transformer to a suitable potential for operating motors, lights, etc.

It is well to mention a word of caution on this point with regard to experimenting with atmospheric static electricity, and it may be said at the outset that this is not a branch of science to be investigated by those untrained in such matters, as they may be electrocuted,—particularly if an electric storm happens to be in the vicinity. The writer has seen electric sparks jump a gap of several inches across the blades of a aerial switch in a radio-telegraph station, even when an electric storm was only approaching and not yet directly overhead.

To those uninitiated in handling elevated aerial conductors such as radio antennae and balloon cables, etc., it should be noted that the only safe method and the one followed in practically all cases, is to ground such free elevated conductors during electric storms.

If it comes to pass that such plants prove practical and the hopes of Dr. Plauson and other investigators who are working on this problem, are actually realized, the electric current thus obtained from the atmosphere can be utilized directly in the preparation of nitric acid and ozone from the air, thus giving us a sure means of refertilizing the soil.

By suitably transforming the current, it can be further employed on a large scale in the realms of electro-chemistry and electro-metallurgy. A French writer, M. Matignon, has stated that by means of the electrical energy collected upon the surface of six square kilometers (about 2.16 square miles) will result in producing five tons of carbid within 24 hours. This expert further points out that if we assume that we obtain 100 horse-power per square kilometer, it will be possible to develop 100,000,000 horse-power from the total surface of France.

The German writer, who describes the invention of Dr. Plauson, and whose article appeared in *Ueber Land Und Meer,* states that one of the engineer's estimates shows that 720,000,000 horse-power per day can be procured from the atmosphere with an area equivalent to that covered by the German nation.

It is claimed by Dr. Plauson that even with the considerable initial cost of erecting these atmospheric electric collecting stations over the country, the operating factor of the total production cost would be considerably less than that resulting from electric plants operating with coal.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries address to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Making Money from an Invention*

By JAY G. HOBSON

(Conclusion.)

WITHIN a short time everything was arranged to spread the news far and wide about the meritorious sharpener. The following month several prominent magazines carried attractive advertisements of their products. Orders began to come in almost instantly. Dealers commenced to inquire about representation, salesmen were taken on to cover more territory, jobbers were becoming interested in large orders and business began to boom.

The little factory was soon swamped, another building was added, then another, until three times the former manufacturing space was being used. Figures began to reveal the fact that the cost of production was being decreased per article. The turnover was increasing by leaps and bounds. The profits, while smaller on each article amounted to many times the former total.

Over night, it seemed, these boys were actually getting rich. They became quite a factor in the business circles of the city and were soon rated among the very prosperous.

Advertising—telling the world about their product—made the universe their market and every nationality their customer. But had their product been of little value all the money and advertising at their command would not have made success permanent. After the public starts buying a new article or invention it behooves the manufacturer to maintain efficient service in his products so that the satisfaction will continue. Profitable repeat orders result from satisfied customers.

There are several ways to make money from an invention. One is to sell it outright for a certain cash sum, another to sell it to a manufacturer on a royalty basis, and another to form a company and market it. The first plan is the one most tried, but the difficulty encountered in finding a cash buyer discourages the majority of inventors. The second way is easier and often more profitable in the long run. The third I believe is the quickest of all, and undoubtedly the best, if the inventor has some executive ability, plenty of confidence in himself and in his invention and can influence sufficient capital, with the necessary cooperation from the investors to wait until the patent has had time to prove a commercial success.

It takes hard work and considerable time to place an invention on the market. It takes some money too, but money is generally forthcoming if the improvement has merit and possibilities of success. There are people who are always interested in a money-making proposition. They can be found through advertising, through friends and acquaintances, and by giving public demonstrations of the invention.

The American spirit is one of adventure; to take a chance for making big profits. A large number of people have the courage of the western pioneers handed down to them. They enjoy the thrill possible from investing in a prospect and cashing in when it becomes a large success. They understand that to make the big money from a new thing, a person must get in at the start, and sell out after the company has reached the peak of its career.

To wait until a business has become one of the seasoned investments paying the usual rate of interest, is to buy the securities at the top figure, which means paying someone else the big profit which could have been made by getting in on the ground floor in the beginning.

Everybody will lend an ear to the inventor selling an interest in a meritorious proposition where the commercial gain is in evidence. If the inventor first sells himself on the article, he will have little trouble to sell others, this day and time. The day of Bell, Fulton and Howe has gone and with it the many vexing tribulations of scorn, ridicule and abuse they

*No queries are publisht this month owing to the article by Mr. Hobson.

U.S. PATENTS

Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO., Patent Attorneys

Chicago Offices: 1114 Tacoma Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St. San Francisco Offices: Hobart Bldg.
New York Offices: 1001 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... Address.....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c

had to endure, in order to succeed with their inventions.

Today the inventor is encouraged, assisted and boosted along by the people if they are assured that he has ability and is sincere. Often men with money appropriate finances to further the success of some idea they learn to be of value.

So in this wonderful country of one hundred million busy people there is great opportunity for people with new ideas of improvements, to become successful inventors.

He need not be of a mechanical turn of mind. It may be an invention in fruit, clothes, shoes, painting, sculpture, chemistry and beverages. Or it can be an improvement in machinery, houses, wagons, bridges, tents, kitchen utensils, fixtures, glass and hundred of various things always needing improvements.

© 1921, by Jay G. Hobson.

Home Electrics

By G. L. HOADLEY, M. E.

(*Continued from page* 1305)

of the man of the house to have the cutouts for your flat located and marked in such a way that you will know them for certain, as you do not want to be meddling with some other family's fuses. Then open up the switch and replace the fuses as previously outlined. Opening the switch shuts off lights for the other families whose circuits lead to that cabinet-box of course, but it only takes a half minute at most to replace your fuses and the power-house quite often shuts off power for considerably longer periods. It is a perfectly safe way to replace blown fuses, however.

In some large flat buildings the switch is replaced by a fuse block with large fuses. It then becomes necessary to replace your blown fuses with others while the circuit is alive. To do this, open the self-closing hinged lid or door of the cabinet-box and insert a thin wedge-shaped piece of wood in the hinged side of the box to hold the door open. Then stand with both feet on a dry board and use one hand only for replacing one fuse at a time. Be careful not to touch any part of the metal cabinet-box with your hand or your body and replace one fuse at a time, then no shock can possibly be received.

There are several ways of locating your cutout blocks which lead to your flat. Your meter is tagged with your name and it is frequently possible to trace back from this point to the cutout blocks. Another way is to first make sure all switches in your flat are off except one. Then, let some one—your wife for instance, stand before your meter and have her tell you when the meter stops, as you replace one fuse in the various circuits. This will locate only one branch cutout. To locate the others repeat this procedure for each one of the switches in your flat.

The second way previously mentioned: namely, testing out each circuit in the cabinet-box to determine the blown fuse is nearly always preferred by the electrician or others familiar with electricity. Referring to Fig. 7, a test lamp is made by connecting two wires to an ordinary lamp socket. Use a heavy enough wire so that it will retain its shape well and bend it as shown in figure 7. Then, with one hand you can rapidly place the test lamp across the terminals of each cutout in turn. As long as the test lamp lights up the fuses are good, but when a cutout is reached where the lamp fails to light it shows that one or possibly both fuses are blown for that cutout.

U.S. PATENTS

PROTECT YOUR RIGHTS

RECORD OF INVENTION

J REANEY KELLY

Write for "Record of Invention" containing forms establishing evidence of conception.

Send sketch and description for report upon patentable nature and instructions. Preliminary service without charge.

PROMPT PERSONAL - SERVICE

J·REANEY·KELLY

PATENT ATTORNEY

892 SOUTHERN BLDG.

WASHINGTON D.C.

PATENT-SENSE

The Book for INVENTORS and MANUFACTURERS

SIXTH EDITION

"The Book for Inventors and Manufacturers"

SIXTH EDITION

By return mail FREE, Write LACEY & LACEY

Dept K. Washington, D.C.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

PATENTS & TRADE-MARKS

SEND SKETCH AND DESCRIPTION for report on patentable nature, and instructions. Preliminary advice without charge. Full, prompt report in strict confidence. Reasonable terms, reliable service by Registered Patent Attorneys. WRITE TODAY

CLARENCE A. O'BRIEN & CO.

PATENT LAWYERS

1023 WOODWARD BLG. WASHINGTON D.C.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.

Dept. 172 Washington, D. C.

WILLIAM C. LINTON

Consulting Engineer and Patent Attorney

"Inventor's Adviser" Mailed free on request. Gives full information as to Patents, Trade Marks and Their Cost

OFFICES

364 University St., 331 National Union Bldg., Montreal, Canada. Washington, D.C.

PATENTS & TRADE-MARKS

FREE BOOKLET ON REQUEST

MY CLIENTS ARE INSURED AT EVERY STEP TAKEN IN THE PROSECUTION OF THEIR CASES

WARNER I. CURBERLEY, PATENT ATTORNEY, 12 NATIONAL UNION BUILDING, WASHINGTON D.C.

PATENTS

Write for free INVENTOR'S RECORD form for establishing the date of your invention, and INVENTOR'S BULLETIN Confidential Service

WM. H. MULLIGAN, PATENT LAWYER, 110 Woodward Bldg. Washington, D. C.

PATENTS

C. L. PARKER, Formerly Member Examining Corps, U. S. Patent Office. PATENT LAWYER, McGill Bldg. Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 74 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.

MUNN & CO., 618 Woolworth Bldg., N. Y.

Tower Bldg, Chicago, Ill. 625 F St, Washington, D.C. Hobart Bldg., 582 Market St., San Francisco, Cal.

PATENTS

Thirty-five years experience. Send model or sketch for opinion as to patentability. Free "Inventors' Guide." Highest references and personal attention assure best results.

FRANKLIN H. HOUGH

520 Washington Loan & Trust Bldg. Washington, D. C.

Free Book on PATENTS

HOW TO OBTAIN A PATENT

Contains valuable information and advice to inventors on securing Patents. Send model or sketch of your invention for Free Opinion of its patentable nature. Prompt service. 20 years experience. Write today.

TALBERT & TALBERT 4287 TALBERT BLDG., Washington, D.C.

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address The Veritas Science Institute, 1400 Broadway, New York, Desk 15.

Digitized by Google

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

RADIOTRONS

POWER TUBES

RADIOTRONS FOR POWER WORK ARE HERE

U. V.—202 RATED AT 5 WATTS PRICE $8.00

MODEL U. V. 202	MODEL U. V. 203	MODEL U. V. 204
5 watt	50 watt	250 watt
Price $8.00	Price $30.00	Price $110.00
Filament V.—7½ volts	10 volts	12 volts
Filament current—2.35 amps.	6½ amperes	15 amperes
Plate V. 350 volts	1000 volts	2000 volts

Deliveries Begin March 10th

These Radiotrons are new types of Vacuum Tubes of improved operating characteristics, especially designed to provide long operating life.

A complete line of Radiotrons for radio detection, amplification and other power work are now available.

See your nearest dealer for full information

The Radio Corporation's tubes are covered by patents dated November 7th, 1905, January 15th, 1907, and February 18th, 1908, as well as by other patents issued and pending. Tubes licensed for amateur and experimental use only. Any other use will constitute an infringement.

Address all orders and inquiries to

SALES DIVISION, COMMERCIAL DEPARTMENT

RADIO CORPORATION OF AMERICA

233 BROADWAY

NEW YORK CITY

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

MODEL STEAM LOCOMOTIVE

As illustration, with *brazed* water tube copper boiler guaranteed to twice working pressure; *steel frames;* cast iron wheels on steel axles; *high efficiency* gunmetal cylinders; slip eccentrics for reversing.

Total length 3 feet. Gauge 2½ inches. Ready to run. $250.

Full set of machined parts with finished boiler, $110.

(*Requiring the use of hand tools only.*)

FREDERICK DEY, Grand Ave., Englewood, N. J.

D-L[11] INDUCTANCE COILS ½ PRICE

Order Now. Best Coils Given Out First. All Are Good. Some Slightly Shop Worn.

They are unmounted, and cover the wave lengths, as follows:

	Wave-Length	
D-L-25,	130-375	83c
D-L-35,	180-515	85c
D-L-50,	240-730	88c
D-L-75,	330-1030	93c
D-L-100,	455-1460	98c
D-L-150,	660-2200	$1.05
D-L-200,	930-2850	1.10
D-L-250,	1300-4000	1.15
D-L-300,	1550-4800	1.23
D-L-400,	2050-6300	1.30
D-L-500,	3000-8500	1.38
D-L-600,	4000-12000	1.53
D-L-750,	5000-15000	1.65
D-L-1000,	6200-19000	1.88
D-L-1250,	7000-21000	1.93
D-L-1500,	1200-25000	2.05

AMERICAN ELECTRO TECHNICAL APPLIANCE CO.

235 Fulton Street New York, N. Y.

U. S. Bureau of Standards News

(*Continued from page* 1318)

the principles of radio communication and which have been apt to surround the whole matter with an air of mystery, most people believe that the principles underlying wireless transmission are not very well known. On the contrary, radio communication is a natural effect following well-known causes.

The Transmission of Music by Radio

Music can be transmitted by wireless in the same manner as speech or code signals. As an incidental result of research work on radio telephony at the Bureau of Standards, it has been shown that music can be transmitted by radio without loss of quality. The possibilities in this direction are great and very interesting. By this means a concert given in one place may be available to those living at a distance. One way of transmitting music has been to place a phonograph so that the sound from it will pass into the radio transmitter. The Bureau of Standards has made an interesting improvement upon this method, which consists of substituting the carbon microphone, which is the mouthpiece of an ordinary telephone, for the vibrating diaphragm ordinarily used on the phonograph. As a result, the phonograph sound record produces direct variations of electric current in the telephone apparatus instead of producing sound; thus while no sound is heard where the phonograph record is being played, the music is easily heard by those at the distant receiving stations.

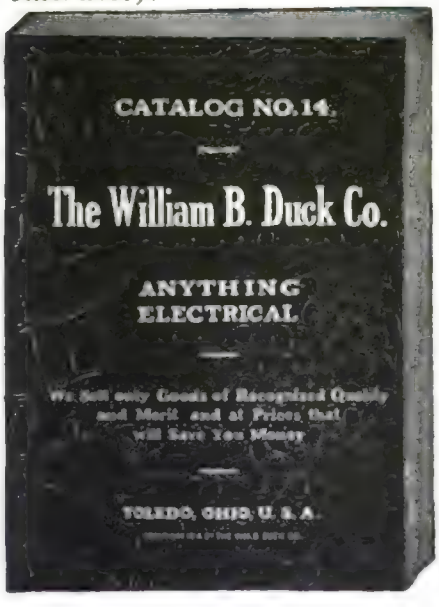
Never in the History of Radio Were These Prices Approached

Improved Navy Type Receiving Transformer again reduced from $27.50 to the startling price of..... **$16.95**

Improved Arlington Receiving Transformer again reduced from $15.00 to the startling price of..... **$7.75**

Substantial reductions on many other radio instruments in our catalog No. 14.
Circular with reduced prices and a large number of new instruments mailed on request.

Mail 12c in stamps or coin (*not sent otherwise*).



"The Greatest Radio Catalog in the World"

The Universal Verdict of Tens of Thousands of Radio Amateurs.

Duck's No. 15 Big 225 Page Wireless Catalog Just Out.

A Veritable Treasure House of Everything Worth While and Dependable in Radio. The largest, most comprehensive, artistic and educational wireless catalog published. The Beacon Light to guide you right in the selection of your radio purchases, and at prices that will command your attention. Every instrument guaranteed with privilege of return if not satisfied.

OTHER SUBSTANTIAL REDUCTIONS ON ITEMS IN CATALOG NO. 14

No. R40 Receiving Set	$22.50
No. R41 Receiving Set	38.50
No. R41a Receiving Set	28.50

THORDARSON TRANSFORMERS

1 K. W. Type R	$40.00
¾ K. W. Type R	28.00
½ K. W. Type R	22.00
1 K. W. Type RS	30.00
¾ K. W. Type RS	20.00
½ K. W. Type RS	15.00
No. A1792 Thord. Condenser	25.00
Nos. 50-51, 52 Switch Contacts, each	.03
No. 1023 Mica Condenser	.60
No. B670 Det.	2.75
No. A862 Det.	2.75
No. A1915 Det.	1.50
No. A367 Murdock Condenser	4.50
No. A1002 Receiving Set	9.75
No. A1916 Condenser	1.65
No. 61x08A Tuning Coil	2.95
No. 61x10 Tuning Coil	$4.95
No. 14 Aluminum Wire per lb.	.90
All Binding Posts Reduced	33⅓ %

ONLY A FEW OF THE MANY NEW RADIO INSTRUMENTS IN CATALOG NO. 15

Type C-300 Cunningham Bulb	$5.00
Type C-301 " " "	6.50
"UV" 200 Radiotron Bulb	5.00
"UV" 201 " "	6.50
Type C-302 5-Watt Cunningham Power Tube	8.00
Type "UV"-202 5-Watt Radiotron Power Tube	8.00
Type C-303 50-Watt Cunningham Power Tube	30.00
No. A200 Control Panel	7.50
A complete line of new detector regenerative and amplifying sets	
Connecticut Variable Condenser	6.50
Turney Spider-Web Unit	6.00
All the new Murdock Panel Type Variable Condensers	
Burgess "B" Batteries.	

Send 12¢ for Our Big Catalog Today

THE WILLIAM B. DUCK COMPANY, 230-232 Superior Street, TOLEDO, OHIO

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Radio "Talk" Relayed to Land Lines

(*Continued from page* 1316)

was this device useful as an aid to navigation, for example during fog, but it automatically served its main purpose of assisting in running down the submarines which then infested the main lines of marine traffic. As soon as a submarine sent a radio message, its direction from one or more destroyers was obtained and the necessary measures taken.

Extreme secrecy was preserved during this training work, even the class rooms being provided with double doors, lest unauthorized persons should catch a glimpse of the special apparatus then employed. In this case, as in others, the unusual equipment, facilities, and willing personnel of the City College enabled it to be of real service to the country.

Radio signals from the great transmitting stations in France, Germany and England were received on the special long distance receivers in one of the Laboratories and the latest methods of recording these in permanent form when necessary, were also made clear.

Another unusual demonstration consisted in showing the way in which the new tubes can be used to *amplify* signals. On another receiving set equipt with such amplifiers of special construction, wireless signals of deafening loudness were obtained. Messages from ships many hundreds of miles at sea rang out with surprising clearness.

Practical Chemical Experiments

BY PROF. FLOYD L. DARROW

(*Continued from page* 1308)

Flame Test for Potassium: If possible obtain a few grams of chemically pure potassium chlorid or some other potassium salt and dissolve in 50 c.c. of distilled water. Preserve this free from contamination in a glass stoppered bottle. Into this solution dip a cleaned platinum wire and as before place in the flame of the Bunsen burner. If the salt is pure a lavender to violet color will appear for a few moments and then disappear. Now observe this flame thru the cobalt-blue glass and note that the color is not cut off.

Testing for Potassium in the Presence of Sodium: Prepare a mixture of solutions of sodium and potassium salts and make the flame test. You will observe that the yellow sodium color completely masks the delicate violet of the potassium and did you not know that the latter element were present you would be totally unable to detect it by direct vision.

Now observe the color of the flame colored by the mixture thru the cobalt-blue glass. The yellow sodium color is thus cut off and the violet of the potassium permitted to pass. In this way we may test for potassium in the presence of sodium.

Other Flame Tests: Prepare solutions of lithium, strontium, calcium and barium salts and make separate flame tests for each one, being careful to clean the wire after making each test. You will find that *lithium gives a beautiful carmine red, strontium a bright red, calcium orange to brick red and barium green.*

Such tests as the foregoing are made in the preliminary examination of unknown substances and as confirmatory tests for substances found in the regular course of qualitative analysis.

Drive Out Aches, Pains

As Well as the Cause of Sickness

Apply thousands of volts of painless, harmless, high frequency electricity without the slightest shock or unpleasant feeling, just an exhilaration of well-being. Aches, pains, soreness, tired feeling, sub-normal conditions depart and the natural joy of good health is restored. You may now do this at home with a

The Vibrant Health-promoting forces of High Frequency electricity, the Violet Ray has accomplished truly wonderful results for others. Learn what it can do for you.

RenuLife

VIOLET RAY HIGH FREQUENCY Generator

Transforms the current from your light socket into this wonderfully effective form of electricity; penetrates deep, saturates entire body; increasing circulation, adding oxygen to the blood, promoting elimination of waste products. The local pain or ache or ailing tissues are directly stimulated while the cause is attacked and the whole system toned and benefited. It's a fundamental treatment working to re-establish normal healthy conditions. That's why it is used and recommended for such a long list of human ills. Get full particulars.

Statement of User

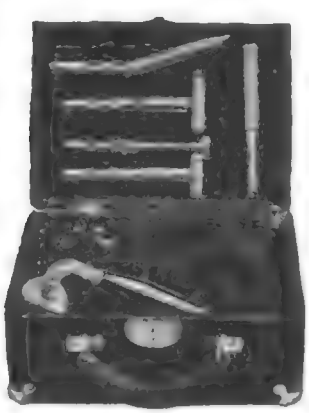
"I had a stroke of paralysis two years ago and spent thousands of dollars seeking a cure but without results. In fact I have derived more benefit from your Violet Rays in three weeks than all other treatments combined. I feel almost certain of a complete cure. My arm and hand are as good as ever and I can walk comfortably and without a cane. I am feeling fine in every way. I cannot express sufficient thanks to you for my wonderful improvement."

NOTE.—Thousands of people, with all manner of ailments, have told us of the benefits, obtained from Renulife self-treatments. If you are in ill-health, learn what relief you may expect from this modern, scientific and simple means.

Liberal Trial Plan

You can determine by actual use at home what benefits you will derive from a Renulife Violet Ray. Send for our book giving full information on the use and success of the Violet Ray. Then decide which model you want to try.

You know that by getting the circulation of pure blood—alive with germ-fighting white corpuscles—flowing through an organ or tissues—that are stagnant or starved—you have started a common sense treatment in the right direction. That's what the *Renulife* does. Learn all about it. Send for full information contained in our book.



SALE DISTRIBUTORS

If you can handle an exclusive territory in a big way, write for attractive proposition.

RENULIFE ELECTRIC CO.

1204 Marquette Bldg., Detroit, Mich.

Netting Bldg., Windsor, Canada

VIOLET RAY BOOK TELLS how the Violet Ray is used for more than 100 different ailments. It is a marvelous story, intensely interesting.

Send For Free Book

Renulife Electric Co.
1204 Marquette Bldg.,
Detroit, Mich.

Please send me, without obligation, a copy of your

RENULIFE BOOK
Health
via
Violet Ray.

Name.....

Street.....

City..... State.....

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

DE FOREST

Talk 30 Miles by "Radiophone"*
with this New Midget Transmitter

(Type O T-3)

MOST perfect radio telephone of its size ever made; complete in every respect. Tests show 30 mile range. Works on any source of direct or alternating current. Tuning by tapped switches. One 6-volt storage battery required; for filament, microphone and "B" Battery. Receptifier or Motor Generator Supply may be used. Set mounted on two separate Bakelite panels, each 4½ x 9 in., clamped together as shown. Prices listed are without tubes, microphone or power supply. Get details of this latest development at once. Order now, thru your dealer or direct.

* "Radiophone"
Name Copyrighted

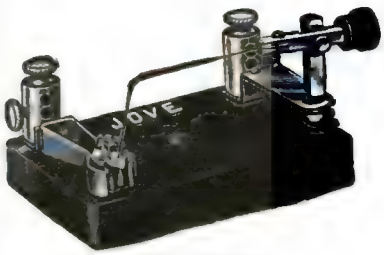
Deforest Radio Telephone & Telegraph Co.

Inventors and Manufacturers of High Grade Radio Apparatus.

1399 Sedgwick Ave. New York City

Aerial Oscillating Circuit Panel. Contains all Controls and transfer key switch. This Panel is $55.00.

Power Tube Panel. Contains tubes, ammeter and filament rheostat. Price this Panel, $45.00.



(GHEGAN PATENT)

Bunnell INSTRUMENTS Always Reliable

JOVE DETECTOR

Handiest, Handsomest, Best
Sample by Mail — $2.00
Tested Galena Crystal—25c

Distributors of Standard Electric Novelty Company Type B "Cyclone" Audion Batteries. Also De Forest, and all other makes of High Class Wireless Apparatus.

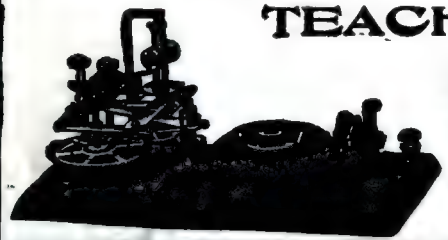
Send stamp for new edition 42E Catalog.

J. H. BUNNELL & CO., 32 Park Place, New York

"THERE'S MONEY IN IT"

AT HOME **LEARN TELEGRAPHY** AT HOME
MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter, THE OMNIGRAPH. Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

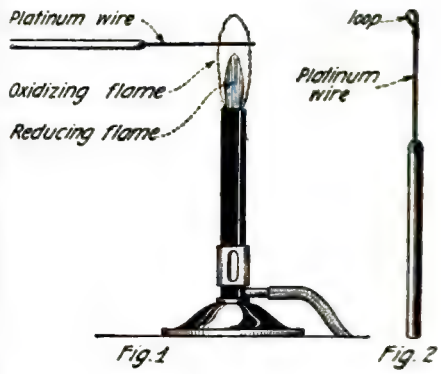
OMNIGRAPH MFG. CO.
26 L Cortlandt St. New York

PIMPLES
Blackheads—Acne Eruptions
Now Are Easily Removed at Home at a Small Cost!

Banish those unsightly blemishes easily and quickly by using "CLEAR-TONE"—a simple home treatment that has cured chronic cases of long years standing. Use like toilet water. Leaves the skin clear, smooth and without a blemish. Has made many friends with both men and women. Elegant for men after shaving. If you have ***Pimples, Blackheads, Acne Eruptions*** on the face or body, ***Enlarged Pores, Oily or Shiny Skin***—never mind how bad—"CLEAR-TONE" has cured the worst cases I ever saw. FREE—simply send name today for *FREE Booklet*, "A CLEAR-TONE SKIN," telling how I cured myself after being afflicted for 15 years. And I know every embarrassment one has to endure with a bad complexion. $1,000.00 Cold Cash says I can clear your skin of the above blemishes.

E. S. GIVENS 168 Chemical Building KANSAS CITY, MO.

Spectroscopic Analysis: The spectroscope is one of the most wonderful instruments at the disposal of the trained



Apparatus Used in Making a Flame Test.

chemist. It places between the eye of the observer and the flame being examined an optical device that increases to a marvelous degree his ability to detect the presence of minute quantities of unknown substances. By its aid he is able to determine the chemical composition and physical state of the infinitely distant stars and nebulae. Every element in the state of incandescent vapor will give by means of the spectroscope a characteristic bright-line spectrum, i.e., a dark background crost at right angles by a series of bright lines separated by intervening dark spaces. By the color of these lines and their position in the spectrum the presence of an element is known with absolute certainty.

An accompanying photograph shows the spectroscope in use. For home laboratory work a small direct vision spectroscope may be had at a very moderate outlay.

Borax Bead Tests: Another series of tests of great value to the chemist are the so-called *borax bead tests.* Borax is a flux, i.e., it is able to dissolve metallic oxides and many of these oxides give to the bead characteristic colors.

Make a small loop on the end of your platinum wire as shown in Figure 2. Heat the wire in the oxidizing flame of the Bunsen burner and quickly thrust it into some borax powder. The powder will cling to the hot wire. Then place the wire again in the flame and the borax will melt into a clear glassy bead which by a repetition of the process may be made to fill the entire loop.

While the bead is still hot touch it very lightly to a small crystal of some cobalt salt such as cobalt nitrat. Upon reheating in the flames the borax will completely dissolve the cobalt compound and become

Fig. 3—Heating a Compound on a Stick of Charcoal by Means of the Blowpipe.

Digitized by Google
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

a deep blue in color. Therefore should this test be made on an unknown substance and a blue color result, *the presence of COBALT would be proved.*

Because cobalt gives a blue color when fused with vitreous substances, it is used to color glass.

To remove the bead thrust it into cold water while still hot and it may easily be removed with the fingers. Then prepare a fresh bead and if it is still colored remove it and repeat until one that is colorless is obtained. In the same manner as cobalt was tested make tests for compounds of manganese, chromium and iron. After each test make a fresh bead. Each metal will give a characteristic color but in the case of manganese only a very minute particle should be used, or the resulting color will appear to be black. Iron will give a light yellow in the oxidizing flame and a green in the reducing flame when allowed to cool, but the color will be brownish red while hot. Chromium gives green both hot and cold and manganese a wine red if heated in the oxidizing flame. Copper compounds give a green color while hot and a blue when cold. Nickel and bismuth compounds may also be tested with the borax bead. When heated in the oxidizing flame, nickel gives a violet color if hot and a reddish brown if cold. Bismuth is yellowish brown when hot and light yellow when cold.

Cobalt Nitrat Tests: Obtain a small rectangular piece of willow charcoal and a brass blowpipe. Also prepare a solution of cobalt nitrat carrying a stopper fitted with a medicine dropper.

At one end of the charcoal stick hollow out a small cavity and place in it a little of some zinc compound. Moisten it with a drop of water. Then, having adjusted the Bunsen burner flame to rather small dimensions, hold the stick of charcoal in the left hand and direct the flame of the blowpipe upon the zinc compound. You will observe that the zinc residue becomes yellow when hot and white when cold. Now moisten the residue with a drop of cobalt nitrat solution and reheat with the blowpipe. This time you will obtain a green color. See Figure 3.

Clean out the cavity in the charcoal stick and repeat the test using some aluminum compound as alum. After adding the cobalt nitrat and reheating you will obtain a blue color.

With magnesium compounds, as Epsom salts, a delicate rose color appears.

Heating on Charcoal with Sodium Carbonat: Using the charcoal stick and blowpipe as before, heat a mixture of dry sodium carbonat and some copper compound. A metallic globule without any incrustration about the edges of the cavity will result.

A silver compound similarly heated will also give a metallic globule without incrustration.

Compounds of lead and tin heated with sodium carbonate yield incrustrations accompanied by malleable beads of shining metal, while antimony and bismuth give brittle beads.

Iron, cobalt and nickel will give magnetic particles that will be attracted by a magnet.

If you obtain from some unknown compound after heating with sodium carbonat a mass which, when moistened on a silver coin, stains it brown or black, sulfur compounds are present.

Marsh's Test for Arsenic: A somewhat famous test for arsenic, and one which has been used in many cases of arsenic poisoning, is carried out as follows:

First let me say that the gas, *arsine*, which is generated in this test is *exceed-*

(*Continued on page 1354*)

40 Years of Progress with Fine Tools

"--all Richmond turned out."

When America's first electric trolley cars were run in the streets of Richmond, Va., in 1887, the whole city turned out to watch them.

Even then, when electric cars were the newest sensation, machinists had already learned that the name of Starrett on a tool meant unfailing accuracy and long service.

The highly-skilled mechanics who build the electrical machinery of today know that they can depend upon Starrett Tools—on the Starrett standard of precision that never varies.

2100 fine tools—with forty years of "knowing how" behind them—are described in the Starrett Catalog No. 22 "L E" Write for a copy. It's free.

THE L. S. STARRETT COMPANY
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

Use Starrett Tools

42-124

Free Trial

YOU may have any instrument with complete musical outfit, for a week's free trial at home. No obligation. Return it at our expense after trial if you wish. Outfit includes velvet lined case, self instructor, music and all accessories at factory cost. A tremendous saving.

Convenient Monthly Payments

A few cents a day will pay for instrument and outfit if you decide to keep it. Wurlitzer instruments are known all over the world for artistic quality.

Send Coupon for Beautiful New Catalog

Every instrument known illustrated with price, easy terms and free trial blank. Catalog absolutely free. No obligation. Send this coupon now.

The Rudolph Wurlitzer Co., Dept. 1251
117 E. 4th St., Cincinnati, O.—329 S. Wabash Ave., Chicago
120 W. 42nd St., New York, N. Y.

Send me your new catalog illustrated in color with full details of Wurlitzer Complete Outfits and free trial and easy payment offer.

Name _____

Address _____

(State instrument you are especially interested in.)

Trade Mark Registered
WURLITZER
200 YEARS OF MUSICAL INSTRUMENT MAKING
Copyright 1920 Rudolph Wurlitzer Co.

Digitized by Google Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Let

CONTINENTAL

fill all your radio needs — wherever you live—from their wonderfully complete stocks, by mail, with

ACCURACY : SPEED : COURTESY

Order direct from this ad. Send your remittance, preferably by check or P. O. Money Order. Your goods will be shipped the day we receive the order.

PARAGON R. A. TEN

Regenerative Short Wave Receiving Sets. "The weaker the Signal, the stronger the Amplification." Price, Eighty-five Dollars.

TELEPHONES	
No. 55 Murdocks 2000 ohms	$4.50
No. 55 Murdocks 3000 ohms	5.50
Brandes "Superior" 2000 ohms	8.00
Brandes "Trans-Atlantic" 2800 ohms	12.00
Brandes "Navy Type" 3200 ohms	14.00
Baldwins Type C Navy Standard	16.50
Baldwins Type E Superior-Sensitive	20.00
Century 2200 ohms. (Govt. Standard)	12.50
Century 3200 ohms. (Govt. Standard)	14.00
Brown 4000 ohm imported super-sensitive double armature	20.00
TRANSFORMERS (Acme new type)	
Acme 250 Watt, mounted	16.00
Acme 250 Watt, unmounted	13.00
Acme 500 Watt, mounted	22.00
Acme 500 Watt, unmounted	18.00
Acme 1000 Watt, mounted	33.00
Acme 1000 Watt, unmounted	28.00
VACUUM TUBE SOCKETS	
No. R-300 DeForest	1.50
No. M-300 Marconi	1.50
No. 55 Murdock	1.00
No. 156 Gen. Radio	1.75
No. R-400 Inverted Type	2.40
VACUUM TUBES	
Radiotron U. V. 202 5 watt transmitting tube	8.00
Radiotron U. V. 200 Detector tube	5.00
Radiotron U. V. Amplifying tube	6.50
Electron relay	6.00
Moorhead Amplifier	7.00
Moorhead extra hard Tubes	7.50
Audiotron	6.00
ROTAY SPARK GAPS	
Bell Gaps in stock	55.00
Benwood Gaps	30.00
Benwood Gaps (Bakelite Case)	27.50
Large Murdock Gap	30.00
Grebe Synchronous Gap	140.00
LINE PROTECTORS	
No. 379 Murdock line protector	9.00
No. AM888 Dublilier line protector	4.00
No. CD888 Dublilier line protector	6.00
TUNGAR RECTIFIERS	
Two Ampere Tungar complete	18.00
Five Ampere Tungar complete	28.00
Two Ampere Extra Lamp	4.00

Our 112-page catalogue, containing tables for quickly figuring all radio calculations, the conventional signals and abbreviations, etc., mailed anywhere in the world for 25 cents.

CONTINENTAL

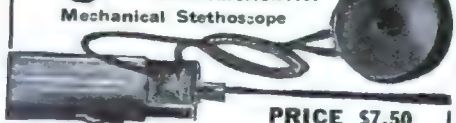
RADIO & ELECTRIC CORP.

J. DiBlasi, Sec. J. Stantley, Treas.

Dept. A13 6 Warren St. New York

SKINDERVIKEN TRANSMITTER BUTTON

Made in several types for use wherever a transmitter is wanted. *Send for instructions and literature No. 1000.*



Mechanical Stethoscope

PRICE $7.50

Improved type for detecting knocks in all running machinery. Test your automobile motor. Descriptive literature sent on request, *without obligation.*

GENERAL SOUND TRANSMISSION CORP.
Room 507 2 Rector Street New York

Secure Rule

I TEACH BY MAIL

WRITE FOR MY FREE BOOK "How to Become a Good Penman" and beautiful specimens. Your name elegantly written on a card if you enclose stamp. Write for it today. P. W. TAMBLYN, 624 Keyser Bldg., Kansas City, Mo.

Scientific Lifting Stunts for Your Parlor

(*Continued from page 1281*)

Fig. 4 shows how the lift is made. One of the committee stands behind the subject and places the index finger of each hand under her arms. One man is placed on either side of her in a stooping position and each places one finger under either foot, while the fourth man stands directly in front of the subject and places one finger sidewise under her chin.

MISS ANNIE ABBOTT, THE "GEORGIA MAGNET," DEFIES FIVE MEN TO LIFT HER.

A surprising fact is that by careful observation and experiments, first instituted by Dr. Leon Lansberg, and publisht in a recent article by Miss Grace Nicholas of the New York *Evening World*—Miss Nicholas was able to duplicate the lifting stunts performed by Miss Abbott—such as defying five men to lift her.

At Figure 5 is shown the best and in fact the only way in which a woman, or man, can be lifted; that is, they must—as Dr. Lansberg pointed out—lock their arms or rather their elbows tight to the body. Try this on your wife, sister, sweetheart or mother, and even if she weighs 140 pounds or more you will be surprised how easily two men, with one hand under either of her elbows and the other hand grasping her hand on either side, can lift her 10 to 12 inches above the floor.

At the offices of the New York *Evening World* where the writer was present and assisted in the demonstrations given by Miss Annie Abbot, Miss Grace Nicholas, an athletic young lady, weight about 130 pounds, successfully resisted the efforts of five muscular men to lift her from the floor.

Now for the secret, as it was pointed out by Dr. Lansberg: The subject who is to be lifted, first permits her arms to be held in (or holds them in tightly against the body) and the lift is at first "allowed" with two or perhaps five men, to show that she *can be lifted* up while the "magnetic power" is switched off.

After a little coaching of your lady subject, and after a few experiments, you will find that the secret of *resisting the efforts* of five husky men to lift her from the floor is accomplisht by allowing her arms to remain flexible and loose from the shoulders, so to speak, and not to tense the muscles.

Another one of Miss Abbott's tricks is to have a number of men stand in a row back of her, while she places her hands against a wall and braces her body and arms.

HOW JOHNNY COULON WORKS HIS MARVELS.

Much mystery and secretiveness has surrounded the performances of Johnny Coulon, who has successfully demonstrated to the French public that he cannot be lifted when he "so wills it," by even the most powerful man, including the champion weight lifters of France: Johnny Coulon weighs 110 pounds.

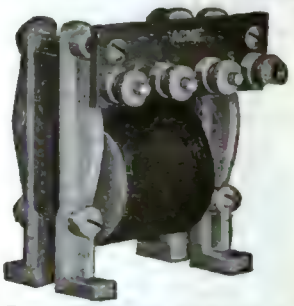
When ready for the lift, Johnny Coulon allows the lifter to raise him by the waist. Of course the hands must come in contact with the bare body. This, according to the investigators, is quite a hindrance, the hands slipping away rapidly due to the velvety skin effect. Coulon now places his right hand upon the wrist of the lifter and the index finger of his left hand upon the jugular vein region in the neck and by pressing upon both points defies the strongest man to lift him.

Digitized by Google

Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ACME

AMPLIFYING TRANSFORMERS



GUARANTEED!

The Acme Apparatus Co. has, after much time and expense, developed an amplifying transformer with a guarantee against mechanical defects.

We will replace any coil which open circuits!

When you buy an ACME Amplifying Transformer your costs for this part of your equipment ceases.

ACME APPARATUS CO.

28 Windsor St. Cambridge, 39, Mass.

Transformer and Radio Engineers and Manufacturers

Service-- the Keynote

There is no guesswork about what GREBE RADIO apparatus will do. In design, workmanship and material it is built for the most exacting Service.

GREBE RADIO

apparatus is licensed under the original Armstrong and Marconi patents.

Our guarantee is absolute and unconditional. Each instrument must give satisfactory service.

If your dealer doesn't carry our line, write us—mentioning his name—for catalogue.

A. H. Grebe & Co., Inc.

70 Van Wyck Blvd., Richmond Hill, N. Y.

PITTSCO

RADIO EQUIPMENT

Our catalog No. 22 illustrates everything in wireless. Send 10 cents in stamps for it.

F. D. PITTS CO.

Boston, Mass.

12 Park Square Dept. D

J. Skinderviken

TRADE MARK

Skinderviken Transmitter Button

U. S. and Foreign Patents

J. SKINDERVIKEN

Inventor and Sole Manufacturer

$1.00 154 W. Randolph St. Chicago, Ill.

LEARN WIRELESS

At the **OLDEST, LARGEST** and **BEST EQUIPPED** school of its kind in New England. Thousands of satisfied graduates all over the world. Splendid opportunities in the Merchant Marine. Day and Evening classes. Start any Monday. Illustrated Prospectus for the asking.

EASTERN RADIO INSTITUTE

899E Boylston St. Boston, Mass.

LIBERTY AUTOMATIC REVOLVER

HIGH QUALITY - RIFLED BARREL - GOOD VALUE

With Shell-Ejecting Device
PRICE $9.50

.22 Cal.
.32 Cal.
.38 Cal.

One of the most powerful and effective weapons made. The shots can be fired rapidly and in succession, as fast as you can count. The ideal weapon for Express Men, Bank Agents, Pay Roll Clerks, Automobilists, and all others where quick action is absolutely essential. Accidental discharge impossible. Another feature is the **Automatic Shell Ejector**, that throws the empty shells out when the barrel is tipped down. The Revolver is exceptionally well made of the very finest of materials and scientifically tested for accuracy. Fitted with fancy rubber handle. .22, .32, or .38 calibre. **PRICE $9.50, postpaid anywhere.** **Cartridges for above Revolvers - by express only. .22 cal. $1.00 per 100. .32 cal., $2.50 per 100; .38 cal., $3.50 per 100.**

BLANK CARTRIDGE PISTOL

PRICES 50c. $1.00

This well made and effective Pistol is modelled on the pattern of the latest type of Revolver, the appearance of which alone is enough to scare a burglar, while it, when loaded, will probably prove just as effective as a revolver with real bullets, without the danger to life. It takes the standard .22 Calibre Blank Cartridges, that are obtainable most everywhere. Even the most timid woman can use it with perfect safety and frighten a thief without risk to herself or anyone else. **A Great Protection Against Burglars, Tramps and Dogs.** You can have it lying about without the danger attached to other revolvers. We sell lots of them around the 4th of July. Well made of Solid Metal. **PRICE ONLY 50 CENTS Postpaid. Better make and superior quality for $1.00. Blank Cartridges .22 cal., shipped by express only, customer paying expressage 50c per 100.**

MELIOR AUTOMATIC PISTOL

SHOOTS .25 CAL. COLT Cartridges

Note Positive Safety Lock Accidental Discharge Impossible

Best value in Automatics in America. Shoots Colt .25 Cal. Automatic Cartridges. **7 Quick Successive Shots.** The Pistol takes seven cartridges at one loading; extra magazines can be kept ready for instant reloading. Each empty shell is automatically ejected immediately after firing. Fixed stationary barrel, ensuring great accuracy. Trigger action is exceptionally light and quick, and must be pulled back for each shot. Never misses fire or jams. Has Safety Lock for disconnecting the pistol when not in use. **LENGTH OVER ALL - less than five inches, 2 in. Barrel.** Material, workmanship and finish of the highest possible grade throughout. A wonderful combination of **ACCURACY** and **RELIABILITY.** Superb shooting qualities; as easy to aim as pointing the finger; works as smooth as an engine; will shoot through four inches of pine wood. Fine for target shooting. Weighs only 12½ oz. Sold under postive guarantee to shoot equal to any pistol on the market or money refunded. **PRICE, $15.00 ppd. Cartridges** (express only) **$3.75 per 100.**

MELIOR AUTOMATIC .32 CALIBRE PISTOL

This Pistol may also be had in 32 Calibre, same as above, length of barrel nearly 4 inches, length over all less than 7 in. **PRICE, $20.00 postpaid. .32 Cal. Automatic Cartridges,** (by express only) **$4.50 per 100.**

"The Baby" Double Action Hammerless Revolver

A Handsome and Most Effective Weapon. Measures But 4¼ Inches Long. Takes Regular .22 Calibre Cartridges $5.00

The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability.** It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Everyone should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and tested to be thoroughly appreciated. The ammunition used is the standard 22-calibre cartridge obtainable anywhere. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. **The price of the Baby Revolver is only $5.00, sent by mail, p.p.d. to any address.**

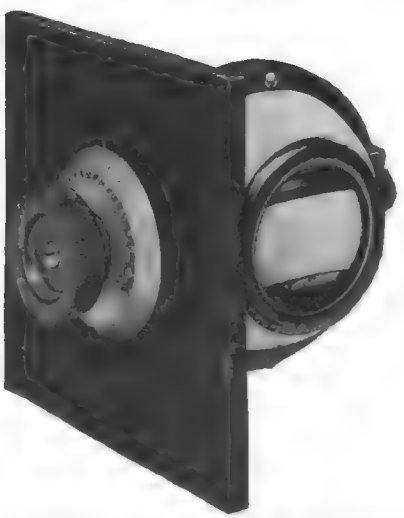
Write For FREE Catalog of Revolvers.

JOHNSON SMITH & COMPANY, Dept. P.M. 72, 3224 N. Halsted St., CHICAGO

THE LATEST **"MURDOCK"** VARIOMETER

No. 345 "MURDOCK" VARIOMETER

$7.50



THE PRICE IS *UNUSUALLY LOW*

THE QUALITY IS *REMARKABLY HIGH*

WINDING FORMS ARE "MURDOCK" MOULDED

No. 55 Head Phone

The continued great demand for these receivers is a wonderful tribute to their extraordinary value, by thousands of satisfied customers. If you are skeptical as to the possibility of so much value at so small a cost, ASK YOUR DEALER. We suggest a trial with the assurance of "satisfaction or your money back."

BULLETIN No. 20 Sent anywhere on request.

2000 OHM. **$4.50**
3000 OHM. **$5.50**

Wm. J. Murdock Co., 55 Carter St., Chelsea, 50, Mass.
509 Mission St., San Francisco, Cal.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Learn

Electricity

in your own home with

Real Electrical Devices

HERE is a new way to learn the highlypaidprofessionofelectricity. You study with and work on laboratory unit boards right in your home in your spare time just as if you were here in this big, world-renowned school with its wonderful equipment. Thus you gain a complete, practical knowledge and experience in less time with less effort than with the older methods of instruction.

Electrical Apparatus For Home Experiments

Wonderful, cleverly constructed units of electrical apparatus are supplied to each student while learning. These home laboratories are not toys, but life-size, expensive instruments and devices which the electrical expert meets with in everyday work. In this way you gain thorough, practical electrical education at home. Thorough, yet simple, tests enable you to work out problems on your instrument boards. You receive the theory as well as the practice of electrical application, which in a short time will enable you to step into a highly paid electrical position.

Big Field—Big Pay

The opportunity for the well trained, electrical man is practically unlimited. Billions of dollars are invested in this great industry. Thousands of men are employed in it, but the demand today is for men who are trained specialists. These men command handsome salaries—$2,500 to $6,000 and up to $10,000 a year and more. You can easily get into this fascinating, highly paid field of work through our thorough method of instruction and the electrical apparatus that is sent to you for home study.

Write Now for Big Free Book

Send the coupon today for full details on our laboratory unit method of home study and information regarding consultation privileges, our free employment bureau and other special services.

Mail the coupon, now, and begin immediately.

Extension Division

SCHOOL of ENGINEERING of Milwaukee

Dept. SI-4, 373 Broadway, Milwaukee, Wis.

Extension Division,
School of Engineering of Milwaukee,
Dept. SI-4, 373 Broadway, Milwaukee, Wis.

Please send your free catalog and details of your laboratory unit method of home study in Practical Electricity. This request obligates me in no way.

Name.....

Address.....

Town..... State.....

Age..... Education.....

Practical Chemical Experiments

(*Continued from page* 1351)

ingly poisonous, and, therefore, the utmost caution must be observed at every point to see that all joints are perfectly tight and that no gas escapes into the room.

The apparatus consists of a hydrogen generator, a calcium chlorid drying tube and a hard-glass delivery tube drawn out somewhat at the end and bent upward. At the middle of the tube is placed a Bunsen burner carrying a fish-tail tip. See Figure 4.

In the generator place zinc and dilute sulfuric acid to generate hydrogen. Collect some of the hydrogen by placing an inverted test tube over the end of the delivery tube and after a few moments present the inverted tube to the flame of a Bunsen burner kept at some distance from the apparatus. If a sharp explosion occurs the hydrogen is still mixt with air. Repeat the test until the gas burns quietly. Then light the escaping gas at the end of the delivery tube.

At the same time have ready a solution of arsenious oxid, ordinary white arsenic,

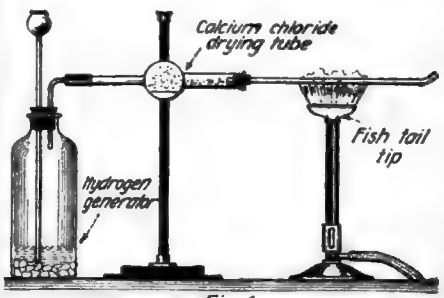


Fig. 4

Fig. 4. Making Marsh's Test for Arsenic.

in concentrated hydrochloric acid. Pour down the thistle tube into the generator a *few drops* of this solution. Immediately the colorless hydrogen flame changes to a lavender color and a garlic-like odor is evident.

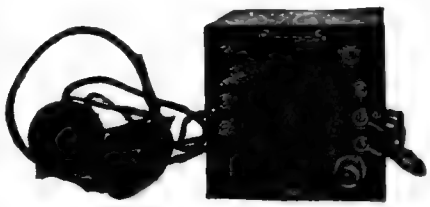
Light the burner with the fish-tail tip and heat the tube strongly. Just beyond the heated portion you will observe a deposit of arsenic which appears as a shining, brownish-black mirror.

Then hold in the flame by means of tongs the lid of a porcelain crucible. A shining deposit of metallic arseni[c] will at once appear. The nascent [hy]drogen evolved in the generator unite[s] [wi]th the arsenic compound to form the [gas] *arsine.* Arsine is a very unstable com[pound] and both the heating of the tube a[nd] the cooling of the gas by thrusting [it] the porcelain crucible lid decom[poses] it with the deposition of arsenic.

At this point the generator will be full of the *poisonous arsine!* To be safely rid of it carefully pour water down the thistle tube, being careful to keep the tube full so as not to admit any air and thus make an explosive mixture in the generator. As the contents of the generator are forced out the arsine will burn at the end of the delivery tube which must not be allowed to go out.

To determine whether a person has met death from arsenic poisoning the contents of the stomach are pumped out, thoroly extracted, filtered and reduced to small volume. A little of the solution thus obtained is introduced into the hydrogen generator and the test carried out as above.

wireless for everybody



WITH this new Amrad Crystal Receiver you can pick up distant wireless telephone and telegraph messages any time, anywhere.

No elaborate aerial, batteries, license or special knowledge required. Easy to set up. Fascinating to operate.

Portable, compact, convenient. Only 5 x 5 x 7". Wavelength range 180 to 750 meters. Tunes sharply by simply rotating the knob. You can use an indoor antenna or the complete installation we furnish.

How often have you marvelled at the mystery of wireless? This wonderful phenomena has gripped the interest of thousands during the past few years. The Amrad Crystal Receiver brings this constant source of delight to everybody. You can now actually have a real "wireless" in your own home and hear the unseen voices of the air. This outfit is not a toy in any sense,—it is just the most practical and efficient Set a leading manufacturer of quality radio apparatus could build.

Illustrated Bulletin Y gladly sent free on request.

PRICES

Amrad Crystal Receiver	**$23.50**
Double Telephone Head Set	**4.50**
Antenna and Ground Equipment	**12.00**

Informative operating instructions included free with each set.

AMERICAN RADIO AND RESEARCH CORPORATION
17 PARK ROW, NEW YORK CITY
Factory and Laboratory:
Medford Hillside, Mass.
Address New York

MASTER CONTINENTAL CODE DODGE SHORT CUT ONE HOUR METHOD INSURES SUCCESS

Thousands have. Everybody can.
Testimonials free. Investigate and win.
Costs 50 cents, Saves 50 dollars.
C. K. Dodge, Box 300, Mamaroneck, N.Y.

$12.50

NEW 1920 REDHEAD PHONES

We announce the new model of the famous Red Head Radio Receivers, greatly improved, 3,200 ohms. $12.50 the pair.

THE NEWMAN-STERN CO.
Dept. E. E. Cleveland, Ohio
Distributors for DeForest, Murdock, Signal, Bunnell and other famous lines.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Kleradesk

Saves time—clears your desk. Sorts, classifies and distributes your correspondence, papers, memos, etc. Occupies much less space than wire baskets. No more shuffling through piles of papers many times daily.

A Steel Sectional Device

Each compartment a separate section. Any number of compartments for flat or vertical filing can be added as required. Width of each compartment is adjustable, one to ten inches. Indexed front and back. Green, oak or mahogany finish.

Write for free, instructive, illustrated folder, "How to Get Greater Desk Efficiency."

Ross-Gould 185 N. 10 St. St. Louis.

KNOBS

We have a large stock of knobs as illustrated. This knob is made of "Insulate" and is 1 inch in diameter with a ¼-inch ¼ threaded shank. Just the thing for rotary switches

No. 4 Knob, each 15c; Per dozen $1.50
Shipping weight, each 2 ozs., per doz. 1 lb.

OTHER BARGAINS

Yos. & McCombs rotary spark gap, shipping weight 4 lbs. $16.00
Yos. & McCombs saw tooth rotor, shipping weight 1 lb. $4.50
Detector variable condenser, shipping weight 2 lbs special price. $6.75
Skit, viken transmitter button, shipping weight 4 oz. $1.00
Acme 2 K. W. semi-mounted transformer, shipping weight 30 lbs. $22.00

Send for our big illustrated catalogue. This amount may be deducted on your first order for $1.50 or over. High printing costs make a distribution impossible.

ELECTRICAL SPECIALTY CO.
Dept. E-50 S. Front St. Columbus, Ohio — Dept. E. 22 N. 9th. St. Philadelphia, Pa.

CONVERT YOUR BICYCLE INTO A MOTOR CYCLE

by using a STEFFEY ATTACHMENT
Simple-Reliable-Economical

Fits any ordinary wheel, diamond, double-bar or truss frame. Easy to attach. Send stamp for circulars.

STEFFEY MFG. CO.
Dept. E, 5025 Brown Street, Philadelphia, Pa.

Learn Autos and Tractors

Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O

AGENTS—Auto Free

We need spec agents to travel by Automobile introducing our great line of National advertised Pure Food Products, Spe and Household Necessities. Here's an opportunity to earn $6 to $12 a day, all or spare time and obtain an Automobile FREE besides. Write at once for al particulars. Address

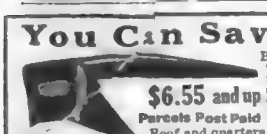
AMERICAN PRODUCTS CO.
3018 American Bldg., Cincinnati, O.

Tire Agent

We want one exclusive representative in each locality to use and sell the new Mellinger Extra-Ply, hand made tires. Guarantee Bond for 8000 miles. (No seconds). Shipped prepaid on approval. Sample sections furnished. Do not buy until you get our Special Direct Prices. Write today.

MELLINGER TIRE & RUBBER CO.
901 Oak St., Kansas City, Mo.

You Can Save $50.00



By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions.

$6.55 and up
Parcels Post Paid

Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

LIBERTY TOP & TIRE CO., Dept. E4, Cincinnati, O.

Flying In Space

By H. GERNSBACK

(*Continued from page 1292*)

explosive charges at the right time and in the right order would be an undertaking that might tax the ingenuity of the best navigator but of course it is not impossible.

Our front cover illustration shows another space flyer imagined by the writer, and this machine contains several new ideas not proposed heretofore. In general principle it is along the lines of the space flyer proposed by the writer in 1915. Generally speaking, the present machine is a sphere about 50 feet or more in diameter and it may be made to rotate at will in a system of rings as shown. These rings crossing at an angle of 60 degrees serve a triple purpose. Firstly, they are used for landing purposes; on them the machine may roll when it reaches its destination, for example, on the moon. Secondly, the rings give the sphere free movement so that it can be turned upon its axis in a manner best suited for landing purposes. Thirdly, these rings contain a wire system which is used to annul gravitation by means of certain currents, not as yet known. By energizing these wires, a counter reaction is set up against the earth's gravitational influences, and the machine will rise to the sky. Upon approaching the moon or other body, the current is again brought into play, and the counter reaction is set up, which gradually decreasing should permit the machine to descend without harmful consequences to the travelers.

It goes without saying that such a machine must be airproof and that the inmates must take cylinders of additional air and oxygen along with them, and purify and renew the air by chemical means by the well-known means carried out today in submarines.

While the idea of the space flyer today may seem extravagant, it is not more impossible than the airplane was thirty years ago, and there is no telling that we all may live to see the day when our present "pipe dreams" become a thing of reality.

MAGNESIUM FROM SEA WATER

According to dispatches from Christiania, Norway, the prominent scientist, Professor Helland Hansen, at a meeting of the Central Committee for Scientific Co-operation in Furtherance of Industry, lecturing on the use of salt water as raw material for Norwegian industry, declared that the new salt works at Bergen, which are now nearly ready, will produce 100 tons of metallic magnesium yearly, the raw materials being only salt water and electric power.

Trip to the Moon

(*Continued from page 1303*)

meteors come unheralded without hiss or noise and bury themselves on the surface of the moon or smash against the rocks, pulverizing the latter as well as themselves instantly. Nothing announces their approach and the traveler only knows of them by the terrific shaking of the rocks or ground on which he stands. In consequence of these meteors, the whole surface of the moon is covered with an impalpable powder made up of iron dust of the meteor and sand caused by rocks being ground to powder through the ages.

Illustrations courtesy Bray Studios.

HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competition is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

AMERICAN SCHOOL
Dept. H-426, Drexel Ave. & 58th St., Chicago

American School

Dept. H-426, Chicago, Ill.

Explain how I can qualify for position checked:

Architect $5,000 to 15,000	Lawyer $5,000 to $15,000
Building Contractor $5,000 to $10,000	Mechanical Engineer $4,000 to $10,000
Automobile Engineer $4,000 to $10,000	Shop Superintendent $3,000 to $7,000
Automobile Repairman $2,500 to $4,000	Employment Manager $4,000 to $10,000
Civil Engineer $5,000 to $15,000	Steam Engineer $2,000 to $4,000
Structural Engineer $4,000 to $10,000	Foreman's Course $2,000 to $4,000
Business Manager $5,000 to $15,000	Sanitary Engineer $2,000 to $5,000
Certified Public Accountant $7,000 to $15,000	Telephone Engineer $2,500 to $5,000
Accountant & Auditor $2,500 to $7,000	Telegraph Engineer $2,500 to $5,000
Draftsman & Designer $2,500 to $4,000	High School Graduate In two years
Electrical Engineer $4,000 to $10,000	Fire Insurance Expert $3,000 to $10,000
General Education In one year	

Name..... Address.....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Do You Use V. Ts?

Then Read This

To get the highest efficiency from a station equipped with vacuum tubes it is absolutely necessary to use a headset of very high impedance. Our High Impedance Navy Type Headset is something new along this line. It has an impedance of 50,000 ohms at 800 cycles, a thing heretofore considered impossible in a commercial headset. We get this high impedance by putting 10,000 turns of wire on each of the four bobbins in the Navy. Ordinary headsets do not have over 7,500 turns to the bobbin and no other develops over 25,000 ohms, whereas the Navy develops 50,000. In spite of this high winding the Navy weighs only 9 oz. complete with headband and cord.

This headset is exceedingly high pitch in tone and is consequently very sensitive to high pitch signals. To anyone wishing to receive trans-Atlantic or Pacific signals it is indispensable.

Its compact, sturdy build insures comfort, reliability and long life. Read our offer below.

50,000 Ohms A.C. Weight 9 oz. Complete with headband and polarity indicating cord. Price $14.00.

BRANDES
MATCHED-TONE
HEADSETS
100% Receiver Satisfaction

While all Brandes Headsets are very light and comfortable they are so sturdily built that there is no danger of them losing their adjustment through hard usage. The shell is made of thick rigid aluminum and the cap of hard, vulcanized rubber. Because the action in our receivers is direct on the diaphragm less current is required to produce audible signals and the space, weight and current consumption of unnecessary amplifying mechanism is eliminated. Our receivers are carefully matched in tone and permanently adjusted at their highest point of efficiency.

They are all equipped with new style woven khaki headbands and polarity indicating cords which eliminate danger of demagnetizing the receivers when used with vacuum valve detectors.

Our Offer

Send us $14 for our High Impedance Navy Type Headset. Try it for ten days. Give it every test you can devise. Make rigid comparisons with the set you are now using. If it isn't a better headset than any you have ever used or seen, or if for any reason whatever you are dissatisfied with your purchase, return the headset to us and we will refund your money immediately.

ALSO MAKERS OF

Trans-Atlantic Headsets, 25,000 ohms A. C. $12.00
Superior Headsets, 2000 ohms D. C.. 8.00

Send 5c for Catalog E.

C. BRANDES, Inc. Room 814
34 Union Square, New York City

Popular Astronomy

(*Continued from page* 1326)

under the tidal changes produced by the larger body. It follows that within that limit the smaller body would have been disintegrated into small particles, or moonlets, under the tidal strains exerted upon it by the earth and would have been gradually distributed about the earth in the form of a meteoric ring which in the course of ages would be absorbed by the earth, *just as Saturn is right now gradually absorbing its rings.*

The planets differ greatly in density. The more distant and larger planets—Jupiter, Saturn, Uranus and Neptune—have densities equal to or less than that of the sun. The densities of the inner planets—Mercury, Venus, Earth and Mars—are relatively extremely high, the density of the Earth's core being about that of meteoric iron. The densities of Mercury and Venus are slightly less than that of the earth and the densities of Mars and the moon about equal to the density of the earth's crust.

It is conceivable that, if a stream of matter were ejected from the sun under the influence of some external force, such as that exerted by a passing star, the outlying parts of the stream would consist of the lighter elements and the lower parts of the heavier elements, since the lighter solar elements lie at or near the surface of the sun and the heavier elements at greater depths. At the time of ejection the lighter elements would be thrown to great distances and would go to form the less dense outer planets; the heavier elements would go to form the inner planets of high density. It is conceivable that ejection of solar material might have taken place under the influence of certain forces at work within the sun itself, such as *electrical repulsion* or *pressure of light* which under certain conditions more than offset the effect of *gravitation.*

It is known that certain chemical compounds form at the surface of the sun in sun-spot regions which are regions of comparatively low temperature and great magnetic intensity. We know next to nothing about the physical state of matter at great solar depths, where abnormal conditions of temperature and pressure must exist, and where great physical changes and disturbances may have taken place in the past. Even today solar activity goes through a cycle of change coincident with the sun-spot period, and many millions of years ago the sun-spot cycle of solar activity may have been far different from what it is today and a far more potent factor in producing changes in the solar system.

Outbursts of novas indicate that agencies making for peace and order are not the only ones at work among the stars any more than they are upon our own planet. The cause of these outbursts has not yet been satisfactorily explained. The theory that they are caused by the close approach of a passing sun or by the encounter of a star with a dark nebula does not account for all of the circumstances of such outbursts and is by no means beyond criticism. The nebulous matter, seen about a nova after the outburst, is now believed to have been expelled from the star itself at the time of the catastrophe and *may conceivably be the stuff of which planetary systems are made.*

At some epoch in the past our own sun may have undergone some such cataclysmic change and this may, conceivably, have been brought about by disturbances within the sun itself. Elements may have been so formed and distributed within the interior of the sun that friction and internal instability resulted and in time produced an upheaval of solar elements with initial velocities so great that, thru electrical repulsion and light pressure, portions of the ejected streams were permanently detached from the sun *and became the nuclei of future planets.*

BECOME AN EXPERT!

SPECIAL COURSES IN

Radio Telegraphy

We train you in a very short time for a first grade commercial license. Experienced Instructors, Complete Laboratory Equipment, including Arc and Spark Transmitters, Employment Service, Dormitories, Rest Rooms.

Morse Telegraphy

A course invaluable to the radio man who wishes to prepare for shore station work; also trains men for positions with the leading telegraph companies. Experienced Instructors, Employment Service, etc.

Arc Transmitters

A course which covers the theory and operation of the arc completely. Given separately or in conjunction with regular radio course. Complete in six sessions.

Typewriting

A special course laid out especially for the telegrapher, both commercial and radio. Special instruction in copying telegraph and radio messages. Experienced Instructors, Employment Service, Dormitories, etc.

EAST SIDE Y. M. C. A. RADIO SCHOOL
152 E. 86th Street, New York City
"The Best Radio School in the East"

Z.R.V. Variometer for $6.50 Short Wave Lengths
Complete catalogs of Radio Apparatus sent for 6 cents in stamps.
CLAPP-EASTHAM COMPANY
131 Main St. Cambridge, Mass.

RADIO CLUB PINS

Special folder of designs and prices in addition to regular School pin catalog free on request. Be sure to see these new numerals which will put new life in your club.

METAL ARTS CO
Dept. 12 Rochester, N. Y.

CONNECTICUT
RADIO EQUIPMENT
Variable Condensers, Transmitters, Hex Bands, Panel Swiches, etc.
Connecticut Tel. & Elec. Co., Meriden, Conn.

200 Big Pages,—
chock full of the latest radio equipment—that describes Kelly & Phillips new radio catalogue, just off the press. Printed on good stock, attractively bound. It lists every reliable make of radio equipment at the lowest prices. Contains valuable information and data that you will use every day. Price 25 cents, refunded on first purchase of $2.50 or over. Send to-day for your copy of the world's largest radio catalogue **KELLY & PHILLIPS,** 312 Flatbush Avenue, Brooklyn, New York

Printing Cheap
Cards, circulars, labels, book, paper. Press for others, big profit. All easy, rules sent. Write factory for press catalog. TYPE, cards, etc. THE PRESS CO., D-37, Meriden, Conn.

Digitized by Google
UNIVERSITY OF ILLINOIS
URBANA-CHAMPAIGN

The Love Machine

By CHARLES S. WOLFE

(*Continued from page* 1300)

"Easily said," jeered the wrathful millionaire.

"Easier done," retorted Parsons, promptly.

"May I ask how you propose to accomplish this miracle?" queried Fennimore, sarcastically.

"I am not telling you what I expect to do, young man," rejoined Parsons, "I am telling you what I am going to do. There is no question whether I am able to get the results I advertise. I know I can. I have the necessary apparatus and the knowledge required to use it."

"Apparatus?" gasped the startled lover, "Do you use machinery?"

"Most certainly," snapt the professor, somewhat nettled, "Did you have an idea that I charmed them with a flute?"

Fennimore ignored the thrust. "When can we begin on this system of yours?" he queried, uncertainly, for the whole thing seemed quite unreal to this lad who had never been accustomed to think of love in terms of ergs or calories.

"We can begin and end just as soon as you can get the object of your affections into my laboratory for a period of two hours."

"Great Scott," gasped Fennimore, "Does one treatment suffice?"

"It does," Parsons replied grimly "Quite."

"Do you guarantee a permanent——er——cure?" Fennimore demanded, determined to go thru with the business, bizarre as it looked.

"I do not," chuckled Parsons, "But I do guarantee it to last long enough to get you past the minister and back from Europe. Say two years. Then if you have any trouble, bring her around for another treatment."

"How am I to get her into your laboratory?" asked Fennimore, satisfied.

"Great Heavens, man," Parsons was exasperated, "If you haven't enough native wit for that task I don't wonder that you have been tagging around without getting anywhere."

"I can't drag her in by the hair of the head, you know," Fennimore interpolated hastily, "It isn't being done at all."

"No, I suppose not," the professor sighed, sarcastically, "And what a pity the fine pointed needle is taboo, too. Well, I suppose I must plan a course of action for you. Convince our young friend that she isn't looking as well as she has been. Tell her that you have heard of some wonderful electric treatments that are getting remarkable results. Tell her that all your wealthy friends are having them. That's the bait she'll raise to. And then offer to pay for a course for her. I think that'll bring her here. Once inside my laboratory, I'll answer for all the rest."

Fennimore arose. "All right, Parsons," he said, "We'll try it. I'll telephone you as soon as I get a definite decision from Violetta."

Parsons smiled quaintly after the departing car. "Before that two year period expires, son," he soliloquised, "You'll be around begging me for the antidote."

It took Fennimore a week to convince Violetta that she needed toning up. Finally, attracted by the price that the young millionaire would have to

CUNNINGHAM Power Tubes

Type C-302
5 watt output
Price $8.00

Demand Cunningham Tubes

The Name is etched on the Tube

C W *Telegraphy and Telephony With Cunningham Transmitter Tubes Offers the Advantages of*

COMPACTNESS — RELIABILITY — LONG RANGE
LOW POWER — SHARP TUNING

Transmitter Tube Specifications

Model	Output Conservative Rating	Filament Amps.	Filament Volts	Plate Voltage	Price	Delivery Date
C 302	5 watts	2.35	7.5	350-400	$8.00	immediate
C 303	50 watts	6.5	10.	1000	30.00	Mar. 10th
C 304	250 watts	15.	12.	4000 Max.	110.00	Mar. 10th

Price of C 303—C 304 fob. New York or San Francisco

C 302 is mounted on the standard four prong receiving tube base. The larger tubes have special bases.

Cunningham Power Tubes

are the latest product of the great Research Laboratory of the General Electric Co. The trade mark GE is the guarantee of their quality. Each tube is built to most rigid specifications. The output ratings are extremely conservative and in actual test deliver greatly in excess of their rated output.

General Electric Quality *plus* Cunningham Service

Address All Communications to

A. T. Cunningham

Trading as
Audiotron Mfg. Company
Dept. S,
35 Montgomery St.
San Francisco, Cal.

WANTED
Railway Mail Clerks
$1600 to $2300
a year in it for you

Men—Boys—Over 17—should write at once

Hundreds of Railway Mail Clerks Needed

Rapid advancement to higher Government Positions. "No lay-offs" because of STRIKES, POOR TIMES, FINANCIAL FLURRIES or the WHIMS OF SOME PETTY BOSS. THE POSITION IS YOURS FOR LIFE.

Country residents and city residents stand the same chance of immediate appointment. Common-sense education sufficient. Political influence NOT REQUIRED.

Write immediately for schedule showing the places and dates of ALL SPRING Government examinations. Don't delay. Every day you lose means the loss of just so much coaching before the rapidly approaching examinations.

FRANKLIN INSTITUTE, Dept. J182 Rochester, N. Y.

FRANKLIN INSTITUTE [The Pathway to Plenty]
Dept. J182, **Rochester, N. Y.**

This coupon filled out as directed, entitles the sender to free specimen questions; a free copy of our book, "Government Positions and How to Obtain Them;" a list of Government positions now open, and to consideration for Free Coaching for the examination here checked.

COUPON

...Railway Mail Clerk	($1600 to $2300)
...Bookkeeper	($1240 to $1440)
...Postoffice Clerk	($1400 to $1800)
...Postoffice Carrier	($1400 to $1800)
...Rural Mail Carrier	($ 720 to $2600)
...Customs Positions	($1100 to $2000)
...Stenographer	($1100 to $2000)
...File Clerk	($1340 to $1640)
...Clerks in the Departments at Washington	($1200 to $1800)

Name ..... Address .....

Use this before you lose it. Write plainly.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

"$5,000 Working for Us!"

"I bought another good bond today and tonight Helen and I were figuring up our investments. All told we now have $5,000 saved and invested where it will add $300 to our income every year!

"I used to scrape along in routine work and spend what little I earned. Then one day my employer gave me some advice. He said success depends on two things. First, learn to do some one thing well. Second, save and invest something out of what you earn each month.

'I decided then and there to get some special training. I wrote to Scranton and found I could get just the course I wanted and study at home evenings. So I started, and it wasn't long before the manager gave me more important work—and more money. I kept on studying with three increases the first year. And each pay day I put something aside. So it has been ever since. As I advanced at the office and my salary grew, my savings grew faster and I put them into good securities.

"Helen was happy as a lark tonight when I told her we had five thousand dollars in safe, sound investments working for us! And this is only the beginning. At our present rate of saving, in a few years more we'll have an independent income for life!"

Success is within easy reach for *you* if you'll just follow the simple rules that have made all men successful who have practiced them. First decide what *your* work is, learn everything about it that you can. The easy, convenient way to do that is to let the International Correspondence Schools help you.

More than two million men and women have taken the up road with I. C. S. help. More than 130,000 are now turning their spare time to profit. Isn't it about time for you to find out what the I. C. S. can do for you? Then mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6188-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	Pharmacy
Electric Wiring	SALESMANSHIP
Electric Lighting	ADVERTISING MAN
Electric Car Running	Window Trimmer
Heavy Electric Traction	Show Card and Sign Paint'g
Electrical Draftsman	RAILROAD POSITIONS
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	Business Correspondent
Ship Draftsman	BOOKKEEPER
Machine Shop Practice	Stenographer and Typist
Toolmaker	Cert. Pub. Accountant
Gas Engineer	Traffic Management
CIVIL ENGINEER	Commercial Law
Surveying and Mapping	GOOD ENGLISH
MINE FOREM'N OR ENG'R	STATIONARY ENGINEER
ARCHITECT	CIVIL SERVICE
Architectural Draftsman	Railway Mail Clerk
PLUMBING AND HEATING	Textile Overseer or Supt.
Sheet Metal Worker	AGRICULTURE
Navigator	Poultry Raising / Spanish
	Automobiles / Banking

Name_____

Present Occupation_____ Business Address_____ 1-1-21

Street and No._____

City_____ State_____

Canadians may send this coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada

NEW MOTOR BARGAIN

GENERAL ELECTRIC

1/4 HP Motor 110 V. A. C. 60 cycle single phase, 1750 Speed. Complete with Cord, Plug and Grooved Pulley.

Will operate $21.00 Washing Machines, Sewing Machines, Small Lathes, Grinders, Bottle Washers, Etc. Satisfaction guaranteed or money refunded.

Illustrated catalog of motors and supplies FREE

HYRE ELECTRIC CO.

631 T. South Dearborn Street Chicago, Ill.

5 Master Keys

The most wonderful and only set of keys of its kind. They open and test thousands of different locks. They have satisfied thousands of purchasers, and are used and recommended by locksmiths, janitors, detectives, and other great key users. They are unequalled as a useful convenient, and household article. Send $1.00 for set and [illegible]

MASTER KEY CO. MILWAUKEE, WIS.

pay for her treatments, the fickle young beauty consented, agreeing to place herself in Parson's hands.

When the last curtain fell one evening she hastened to her dressing room and made ready for her first visit to the professor's laboratory. The impatient Fennimore was waiting for her with his big limousine, into which he piloted her as soon as she emerged from the stage door alley. Half an hour later she was shaking hands with Parsons.

"Rotten of us," she drawled, languidly, as the scientist dropt her limp hand, "Rotten of us to keep you working at this hour. But I just can't get up in the mornings. Habit I formed out in the sticks making night jumps. Nothing really the matter with me, is there, Doc?"

"Haven't had a chance to examine you yet, young lady, but off hand I should say there were several things the matter with you," said Parsons, dryly, as he led the way into his laboratory.

Fennimore shot him a sharp look, started to speak, then changed his mind. The girl, who had not caught the hidden meaning of the scientist's remark, rattled on, waxing doubly garrulous as she caught sight of the formidable array of electrical apparatus and switchboards in the sanctum. Had either she or Fennimore been versed in such matters they would have been able to identify several familiar pieces of high frequency apparatus, the brass stripped oscillation transformers and burnished Leyden jars being quite conspicuous in the array.

Parsons wasted no time in useless preliminaries. "You first, Fennimore," he said, curtly.

"I," objected the amazed millionaire, "I'm not here for treatment."

"Heavens, man," interposed the professor, testily, "Don't question my methods. I must have your rate."

Fennimore's teeth snapt shut on his unspoken retort, and submissively he took in each hand the peculiar metal electrodes the scientist proferred. He was finding Parsons a different man in the laboratory from what he had been in his consulting room.

The professor, his eyes watching intently the quivering pointer on a meter face, paid scant attention to his two companions. Finally he made some notes on a pad and relieved Fennimore of the electrodes.

"That will do, thank you," he said, "Now I must figure out your rate."

"My rate of what?" demanded the mystified youth.

"The rate at which you are vibrating per second," replied Parsons, none too graciously, "Let's see. The square root of ——. Ah! There we have it. You vibrate, Fennimore, between the twenty-fifth and twenty-seventh octaves. Thirty-seven million, five hundred and fifty thousand and some odd cycles a second, if figures interest you."

"They don't," replied Fennimore, promptly, his eyes feasting on Violetta, "Not that kind, anyway."

Parsons handed the girl the electrodes, and again studied the quivering needle. Again his pencil was busy. Then he faced the pair, a satisfied look on his face which told plainly that he had found what he sought.

"And you, my friend," he said to Violetta, "Vibrate at the rate of thirty-seven million, five hundred and forty-nine thousand and a few odd hundred. There's only about seven hundred cycles difference between you. You're a fine pair of zincs."

CORWIN DIALS

IT is just as easy to specify "Corwins" when buying dials, and it implies that you have quality apparatus throughout. Dealers acquire respect for those who specify good makes of radio goods.

3" Dial, 75c; with knob, $1.30
3⅞" Dial, $1.00; with knob, $1.70

At all Radisco Agencies, or sent postpaid anywhere.

A. H. CORWIN & CO.
4 West Park St., Newark, N. J.

SAVE TIME AND MONEY

By forwarding your Mail Orders to us.

Our central location makes it possible for you to do so.

Amplifying Transformer	$5.00	Baldwin Navy Type Receiver	$16.50
Bamboo Spreader, 12 ft.	2.25	Brandes Superior Receiver	8.00
Electrose Insulator, 10 in.	.75	Murdock Receivers, 5,000 Ohms	4.50 and 5.50
Electrose Insulator Ball	.35	Marko Storage Batteries, 6 V., 40 A.	13.25
Lightning Switch	4.50	Marko Storage Batteries, 4 V., 40 A.	10.75
Antenna Switch	4.50	E. R. Det. Tube	6.00
B. Batteries, 22½ V., 1,200-hour capacity	3.50	Amplifier Tube	7.00
B. Batteries, 4½ V., 200-hour capacity	.40	Transmitter Tube	7.50
Variable Condenser, Conn. .001	6.50	Radistron Det. Tube	5.00
Variable Condenser, C. E. Bal. .001	9.50	Ace V. T. Socket with Grid Leak	1.50
Variable Condenser, Murdock .001	4.75	Wixico Coil Mounting, Table	3.00
		Wixico Coil Mounting, Panel	6.00

Mail orders receive prompt attention. Send 2c in stamps for catalogue.

THE PRECISION EQUIPMENT CO.
Dept. E 2437-2439 Gilbert Ave. Cincinnati, Ohio
"You May Pay More But You Can't Buy Better"

You can Ukulele!

You can easily play quaint, dreamy Hawaiian music or latest songs on the Ukulele. Prof. Harry J. Clarke's latest method enables you now to play the Ukulele in a few weeks. We give you a genuine Ukulele absolutely FREE with complete course of lessons. Write at once for FREE narrative of Hawaiian music and offer. No obligations. Send Now!

Hawaiian Institute of Music, 1400 Broadway, Dept. 5A, New York

TELEGRAPHY

(Both Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities for advancement. Oldest and largest school; established 46 years. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free.

DODGE'S INSTITUTE, Valparaiso, Ind.

Digitized by Google
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ABC Standardized Radio

Sectional Unit Cabinets

A SERIES of cabinets, all standardized including receiving set, VT Detector, VT and one-step combined, one-step, and two-step amplifiers. You start with the receiver (complete in itself) and add on the other sections without discarding one particle of your original equipment.

ABC sectional unit cabinets *look* like professional equipment, *work* like professional equipment, and sell at prices amateurs can afford. That's the result of standardized, automatic production in the best equipped radio plant in the world!

Backed by the *ABC* Guarantee,—"Your money's worth or your money back." *Send a nickel for complete circular.*

Wireless Equipment Co., Inc.
188 Greenwich Street, New York

EXPERIMENTORS

Attention

¼-HP New General Electric Motors
110 Volt—Single Phase—1725 RPM
$22.50

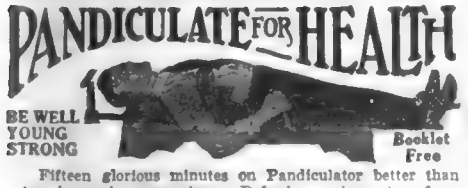
⅛-HP New Westinghouse Motors
110 Volt—Single Phase—1725 RPM
$18.00

VIM ELECTRIC & MOTOR CO.
Incorporated
66-68 Cortlandt Street
New York City

Write It With a 'Vulcan'

Red or Black "Vulcan" Ink Pencil
The only perfect, non-leakable ink pencils at moderate prices. Long or short.
Absolute necessity to any business man or woman. Promotes efficiency. Unequalled for general writing, billing, ruling and manifolding. Made of pure vulcanized rubber with non-corrosive, durable writing point. Lock-Cap prevents leaking. Extra size, 8 ins. black only, $1.75. *Agents Wanted. Big Profits.*
Order today, Postpaid
$1.50
J. F. ULLRICH & CO., 161 Washington St., N.Y.

PANDICULATE FOR HEALTH



BE WELL
YOUNG
STRONG
Booklet Free

Fifteen glorious minutes on Pandiculator better than two hours in gymnasium. Refreshes, rejuvenates; frees impinged, irritated nerves; corrects contracted muscles, spine ligaments; relieves congestion, improves circulation and body drainage. Doctors recommend it. No electricity, no discomfort; delightfully restful. Write now.

PANDICULATOR CO., 332 Prospect Bldg., Cleveland, Ohio

DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my sworn statement of how I recovered my hearing.

A. O. LEONARD
Suite 308, 70 5th Avenue New York City

"Fine pair of zincs," echoed Fennimore, "What the devil, Parsons,——"

"Ever see a dry cell, Fennimore?" Parsons asked, calmly, "Carbon and zinc poles, you know? Well, you're a pair of negatives. You couldn't have succeeded in this case in a thousand years."

"See here," broke in the imperious Violetta, "What's all this about a pair of negatives? When do I get those treatments?"

"Don't worry," Parsons assured her, "You'll get them."

Fennimore faced her doggedly. "Look here, Violetta," he said, determinedly, arms folded, jaw squared, "You may as well know the truth. I've told you a thousand times how desperately I love you. Every time you've laughed in my face. I've grown desperate. I had to do something. The professor here thinks he can arouse in you some love for me by means of these treatments. That's why we're here, and that's why he has to take observations of the both of us."

After one startled moment, the girl gave way to uncontrolled laughter. "Make me love you with a bunch of juice," she gasped, "Oh, Lord. This is rich."

Parsons regarded Fennimore with deep disgust. "Fennimore," he said, icily, "You have, in the language of the street, spilled the beans. Now will you kindly keep your mouth shut before you scatter them so hopelessly that I can't pick them up."

"She had to know sometime," retorted Fennimore, stubbornly, "And it might as well be now."

"She didn't have to know before I got these electrodes on her arm," Parsons shot at him, deftly clamping an arm electrode on each wrist of the unresisting girl, who was paying no attention at all to the busy professor. She was regarding Fennimore with contempt.

"Why, you poor simp," she sneered, "I've told you a dozen times, and I tell you again, that if you had a hundred times the money you have, and if you were a hundred times better looking than you are, I wouldn't marry you if you were the last man on earth. Or any other boob in trousers, either. I've got my work to think of. Do you think I'm going to quit being a chorus girl? Not on your life."

Parsons snapt on a switch and grinned at the disheartened millionaire. "How's that for a mouthful, son? he asked, "Think that will hold you for awhile?"

Then the girl turned on him. "And you, Mr. Smart Guy," she demanded, "How do you expect to change my mind with your foolish old treatments?"

Parsons looked at his trembling meters and smiled. "Easily, my dear," he replied, "Oh, quite so. You see, life itself being of an electrical nature, it obeys the laws which govern electrical phenomena in general. To what extent and by just what means we are hardly in position to say as yet. My own researches have carried me beyond the frontiers in certain directions, and the treatment you are undergoing tonight is just one application of the facts that I have unearthed.

"You young people think that love is a question of good looks, circumstances, and mutual attraction. You have fallen into the common error of mistaking the effect for the cause. No two people will be attracted to each other to any degree—far from sufficiently to love—if their natures aren't tuned properly for the occurrence of the phenomenon. Take your own case, for

LEARN WIRING AND EARN $75 a Week

This latest Edition will make you an Expert

440 Pages
Illustrated

The National Authority for 26 Years

The only complete and accurate book on wiring

CONTENTS

The National Electrical Code, with all its new rules, is explained and illustrated. 52 of the latest and simplest tables which show, at a glance, just what size of wire is needed for any kind and size of lighting, motor or heating installation, for any voltage, current and drop desired for any system, Direct Current, Alternating Current, single, two or three-phase. The latest Code Rules on grounding required on all work.

SPECIAL NEW CHAPTERS

How to install and operate generators, motors, storage batteries and every kind of wiring device with diagrams of connections. Illumination, House Wiring, Garage Wiring, Theatre Wiring, Moving Picture House Wiring, Sign Wiring, Marine Wiring, Electric Range and Heater Wiring, Watt-Hour Meter Wiring and complete chapters on inside and outside wiring for every system from a central station to the smallest cottage. 250 Electrical Units and their Definitions and Equivalents. The latest lamp data. Proper symbols to use to indicate outlets, etc., etc. Also a complete directory of the leading manufacturers of officially approved apparatus and supplies necessary for any kind of installation.

Every inspector in this country will approve your wiring job if done in accordance with the simple rules in Standard Wiring.

Leather Cover. Pocket Size. Gilt Edges. Sent Postpaid on Receipt of $3.00.

H. C. CUSHING, Jr.
6 West 40th Street New York

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

'Watch Bill Brown!'

"He's a comer," said the big boss, "always on the job—courteous, thorough and efficient—never lost a day through sickness since he's been with us. Last winter when two-thirds of the force were home sick with the 'Flu,' Brown did the work of a dozen and pulled us through. He's always in good physical trim. You can depend on him. We want more men like him in this organization. Hereafter don't employ anyone who can't measure up to Brown's physical and health standard. We must have strong, healthy men with lots of pep and vitality—big calibred youngsters with an abundance of physical and mental energy. That kind of a man is worth keeping on the payroll. Put Brown down for another increase in salary and keep him in mind for a bigger job."

STRONGFORT
The Perfect Man

What Does Your Boss Think About You?

Does he think you are an efficient worker—a good producer — a dependable man worthwhile keeping on the payroll, or are you slated for early discharge? If you have neglected your health and failed to measure up to your job, you will soon be a "discarded employee" out on the street with the tail-end failures. Where do you stand?

Your Health Means Your Job!

How do you expect to be mentally efficient with neglected health? Your brain cannot be up to standard when your blood is watery and anemic, loaded with the poisons of Catarrh, Constipation, Indigestion, Biliousness and bad habits and excesses—the results of youthful ignorance. You feel miserably and look twice as badly. You must get strong and healthy or *get out*. It's up to you. What will you do? What will your future be? You can save yourself and your job with

STRONGFORTISM

The Modern Science of Health Promotion

Strongfortism is the Science of Normal Health, Strength, Vigor and Sex Life. It has salvaged thousands of weak, sickly, impotent men out of the bog of miserable failure and despair. It can do the same for you. It will rebuild and rehabilitate you in every part, put new life and ambition into you and make you a success in business, in the home, in society—everywhere. You can be 100% successful with Strongfortism. I guarantee it!

You Want My Free Book

Mark the items on the consultation coupon on which you want special information and send it to me with a ten cent piece (one dime) to help pay postage on my FREE book. **"Promotion and Conservation of Health, Strength and Mental Energy."** This wonderfully instructive book will point your way to a successful, healthy, happy existence. It is a life saver and a job saver. Send for it *right now*.

LIONEL STRONGFORT

Physical and Health Specialist

Department 286, Newark, New Jersey

FREE CONSULTATION COUPON

Mr. Lionel Strongfort,
Dept. 286, Newark, N. J. Personal.

Please send me your book "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH and MENTAL ENERGY," for postage on which I enclose a 10c piece (one dime).

Send me special information on subjects marked X below, without in any way obligating me.

..Colds	..Stomach Disorders	..Despondency
..Catarrh	..Constipation	..Skin Disorders
..Hay Fever	..Biliousness	..Impotency
..Asthma	..Torpid Liver	..Great Strength
..Obesity	..Indigestion	..Falling Hair
..Headache	..Nervousness	..Weak Eyes
..Thinness	..Poor Memory	..Pimples
..Rupture	..Rheumatism	..Blackheads
..Lumbago	..Gastritis	..Round Shoulders
..Neuritis	..Heart Weakness	..Lung Troubles
..Neuralgia	..Poor Circulation	..Female Disorders
..Flat Chest	..Increased Height	..Weak Back
..Deformity (Describe)	..Successful Marriage	..Muscular Development
..Insomnia	..Easy Childbirth	..Advanced Course
..Vital Depletion	..Drug Addicts	..Healthy Children
..Youthful Errors		..Manhood Restored
..Short Wind		
..Flat Feet		

Name.....

Age.....Occupation.....

Street.....

City.....State.....

example. You told the truth when you said that you would not love Fennimore in a million years. Your rates of vibration were so nearly alike that you were, as I said, like poles of a battery."

She regarded him thoughtfully. "Then how, Mr. Man," she asked, "Do you account for the fact that this poor fish is gone on me? Seems to me the rule ought to work both ways to be any good."

"Bravo, little reasoner," exclaimed Parsons, admiringly, "You will be the brains of your household. Well, I account for that quite easily. The simple fact is that HE'S NOT IN LOVE WITH YOU AT ALL."

Fennimore jumped about two feet. The girl looked at the calm scientist in open mouthed amazement. "Say, Parsons, what the ——" burst out the wrathy Fennimore.

"Calm yourself," came the unperturbed reply, "I know what I'm talking about. Bluntly, you've mistaken lust for love. You think you're in love.

"What I'm doing is just this. By a process which I do not choose to reveal, I am changing the rate, or call it natural period, if you like, at which this girl vibrates. When I have changed it sufficiently you will be as far apart as you were together before. In other words, you will be splendidly positive and negative. Then you will love. You won't be able to help yourselves."

Vaguely alarmed at the cool assurance of this man, the girl stirred uneasily in her chair and regarded the quivering meter needles with some apprehension.

Parsons leaned back comfortably against his instrument board and resumed.

"I find that the exact adjustment of these oppositions is quite critical. For maximum manifestation I should have to readjust you to the very cycle. Were I to do that, the attraction would be so violent that you would literally hurl yourselves into each other's arms. That critical state quite frequently occurs naturally, and when it does you see the conventions hurled ruthlessly aside, and every man-made barrier scaled, be it as high as the mountains or as broad as the sea. Let me get the coldest, most haughty beauty of the upper class into this chair, and I can force her to lavish every attention on the dirtiest ash man you can find in the city.

"It is sufficient that we attain a degree of attraction necessary to arouse domestic instincts and impulses." He broke off to study gravely the indication of a large meter. "That state we have about reached now," he said, quietly.

Fennimore started, and regarded the girl intently. For a second she met his gaze. Then her eyes dropt, and she blushed.

Parsons smiled faintly. "I'm a few years ahead of my time, of course," he said, "Within the next few years every couple that applies for a license to wed will have their vibratory rates taken and the corrections necessary to accomplish true affection made. The divorce evil will be wiped out as mis-mating is prevented."

He snapt off the switch and deftly removed the electrodes from the girl's arms. She arose, a trifle unsteadily. Fennimore regarded her anxiously. "How do you feel?" he asked, in some concern.

"A little queer," she replied, dazed, "You'd better take me home, Roderick."

Roderick! The young man's heart pounded within him and a look of exultation came over his features. He faced her squarely. "For the thousand and first time, 'Letta," he said, "Will you marry me?"

say BAYER

BAYER

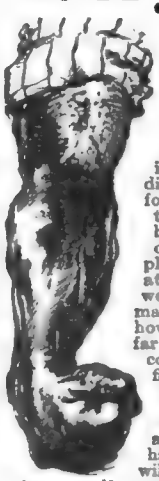
Aspirin

Then It's Genuine

Unless you see the name "Bayer" on tablets, you are not getting genuine Aspirin prescribed by physicians for 21 years and proved safe by millions. Always say "Bayer."

Aspirin is the trade mark of Bayer Manufacture of Monoaceticacidester of Salicylicacid.

There is Strength in Every Tablet



One dose often helps commence to enrich your blood and revitalize your worn-out exhausted nerves—Nuxated Iron is organic iron, like the iron in your blood and like the iron in spinach. It is so prepared that it will not injure the teeth nor disturb the stomach. It is ready for almost immediate absorption and assimilation by the blood while some physicians claim metallic iron which people usually take is not absorbed at all. If you are not strong or well you owe it to yourself to make the following test: See how long you can work or how far you can walk without becoming tired. Next take two five-grain tablets of Nuxated Iron—three times per day, after meals for two weeks. Then test your strength again and see how much you have gained. Your money will be refunded by the manufacturers if you do not obtain perfectly satisfactory results. At all druggists.

NUXATED IRON
For Red Blood, Strength and Endurance

Don't Wear a Truss

We Guarantee Your Comfort

with every Brooks' Appliance. New discovery. Wonderful. No obnoxious springs or pads. Automatic Air Cushions. Binds and draws the broken parts together as you would a broken limb. No salves. No plasters. No lies. Durable, cheap. Sent on trial to prove it. Full information and booklet free.

C. E. BROOKS
237 State St. Marshall, Mich.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

"In 1999"

By B. FRANKLIN RUTH

(*Continued from page* 1302)

peculiar nature of the disturbances could only be explained as the result of some human agency capable of exercising extraordinary powers over the physical universe. After the occurrence of several successive manifestations, the latter were immediately identified as radio-active in origin. It was admitted that atomic disintegration had at last been accomplisht, and that the fate of the world was in the hands of its unknown discoverer, who might destroy the planet at his whim. With deep secrecy science kept its knowledge, and waited for the discoverer to make himself known either as the benefactor or destroyer of mankind.

Early in 1925, the great Indian physicist, Signa Beth, announced his discovery of a method of releasing the immense energy stored in the atom, and his intentions of benefiting mankind. Thus the most momentous discovery ever made by science was disclosed.

From that date, science bounded forward. The commercialization of Signa Beth's discovery and its direct application to the immense stores of energy contained in the atoms of the common heavy elements brought unprecedented benefits to mankind. With almost unlimited power waiting to be unleashed by the pressure of a finger, men laid aside their work and took a holiday. It was like the discovery that water could be turned into steam and made to work for us,—multiplied a million times.

Close upon the discovery of atomic disintegration came that of the transmutability of matter. This was the natural sequence of the analysis of the properties of by-products formed during the successive steps of disintegration. The result of this discovery, as we all know today, was the immediate demonetization of gold and all precious metals. In a day the world was threatened with its greatest financial panic.

Fortunately, there was at the head of our government a man of great foresight and ability who saw the threatened disaster and took immediate steps to avert it. At a joint meeting of the representatives of the various governments, measures were taken to meet the crises, and thru pressure brought to bear from certain sources a coalition of nations was formed under a single government. This we know today as the United States of the World. It was in effect a League of Nations similar to the plan advanced by the great Wilson in 1919. It arranged for a semi-annual world congress at Washington, and enforced its decrees by means of an International Police. Paper notes on the World Government were issued as legal currency, and substituted for all outstanding metal currency. Threatened Bolshevik outbreaks in Russia, and labor crises in Europe and America were immediately quelled by the efficient iron hand of the international government. Thus was civilization again saved from destruction.

One of the most apparent effects of the world coalition was the abolishment of war. The United States, as principal creditor of the bankrupt nations, held a unique position in the league, both as its sponsor and guardian. The

Learn Music at Home—

New Way Makes It Easy

Either Playing or Singing — Every Step Made Simple as A B C by Print-and-Picture Lessons That You Can't Go Wrong On.

Try It On Approval

Entire Cost Only a Few Cents a Lesson—and Nothing Whatever to Pay Unless You are Satisfied.

How often have you wished that you knew how to play the violin or piano—or whatever your favorite instrument may be—or that you could take part in singing?

How many an evening's pleasure has been utterly spoiled and ruined by the admission, "I can't sing," or "No, I am sorry, but I can't play."

At all social gatherings, some one is sooner or later sure to suggest music. When the others gather around for the fun, the one who can take no part feels hopelessly out of it—a wall flower—mere listener and looker-on!

Or those long and lonesome evenings at home when minutes seem like hours—how quickly the time would pass if you could spend it at the piano or organ—or in making a violin "talk," or in enjoying some other instrument.

And now—at last—this pleasure and satisfaction that you have so often wished for can easily be added to your daily life.

No need to join a class or pin yourself down to certain hours for lessons or practice. No need to pay a dollar or more per lesson to a private teacher. Neither the question of time nor expense is any longer a bar—every one of the obstacles that have been confining your enjoyment to mere listening have now been removed.

You don't need to know the first thing about music to begin—don't need to know one note from another. My method takes out all the hard part—overcomes all the difficulties—makes your progress easy, rapid and sure.

Whether for an advanced pupil or a beginner, my method is a revolutionary improvement over the old methods used by private teachers. The lessons I send you explain every point and show every step in simple Print-and-Picture form that you can't go wrong on—every step is made as clear as A B C.

My method is as thorough as it is easy. I teach you the only right way—teach you to play or sing **by note.** No "trick" music, no "numbers," no makeshifts of any kind.

I call my method "new"—simply because it is so radically different from the old and hard-to-understand ways of teaching music. But my method is thoroughly time tried and proven. Over 250,000 successful pupils—in all parts of the world, and including all ages from boys and girls of 7 to 18 to men and women of 70—are the proof. Largely through the recommendations of satisfied pupils, I have built up the largest school of music in the world.

But I don't ask you to judge my methods by what others say or by what I myself say. You can take any course on trial—singing or any instrument you prefer—and judge entirely by your own progress. If for any reason you are not satisfied with the course or with what you learn from it, then it won't cost you a single penny. I guarantee satisfaction. On the other hand, if you are pleased with the course, the total cost amounts to only a few cents a lesson, with your music and everything also included.

Just now I am making a special short-time offer that cuts the cost per lesson in two—send your name now, before this special offer is withdrawn. Instruments supplied when needed, cash or credit.

For Beginners or Advanced Pupils

Piano	Harmony and Composition
Organ	Sight Singing
Violin	Guitar
Drums and Traps	Ukulele
Banjo	Harp
Mandolin	Cornet
Clarinet	Piccolo
Flute	Trombone
Saxophone	Cello

MR. DAVID F. KEMP, President
U.S. School of Music, 1334 Brunswick Bldg., New York City

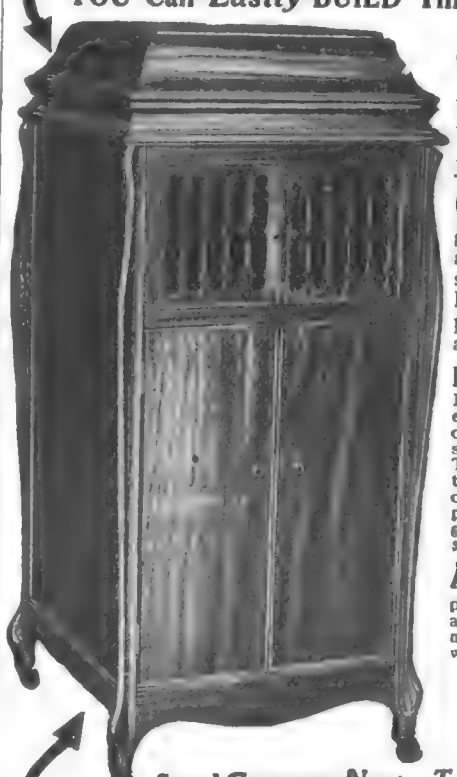
Please send me your free book, "Music Lessons in Your Own Home," and particulars of your Special Offer.

Name .....
Please Print Name.

Address .....

City ..... State .....

YOU Can *Easily* BUILD This PHONOGRAPH



TREMENDOUS SAVING IN COST

You don't need to be a cabinet maker. We have made it an easy and pleasant job with

Our Simplified Plans We furnish blue prints, diagrams, motor, ready-built horn, cabinet pieces and all metal parts complete. You do the assembling, **6 models to choose from.** A few hours' work, and you will have as fine a type of phonograph as any produced, and at a price away below what you would pay in a store.

KEEP THE SAVINGS IN YOUR POCKET

Machines play all records, have a wonderful tonal quality, excelled by none. No need now for any family to be without a phonograph because of the cost. THE MAKAFONE solves the problem. BUILD IT YOURSELF AT LESS THAN ONE-FOURTH REGULAR COST, but equal to the high-priced cabinet machines. Free Records with each outfit. SEND TODAY FOR FREE CATALOG and full particulars of our wonderful offer. *Many a manufacturer got his start in this way. Why not you? Build machines and sell to your friends.*

Agents Attention You can make and sell *these* machines from our plans at a profit of $50 to $75 each. Others are selling two and three a week. Here is your opportunity to make big money and become independent. Pleasant and profitable work.

Send Coupon, Now—To-day

MODERN PHONOGRAPH SUPPLY CO.
557 Springer Bldg., 313 So. Clinton Street, Chicago

Modern Phonograph Supply Co.
557 Springer Bldg.,
313 So. Clinton St., Chicago, Ill.

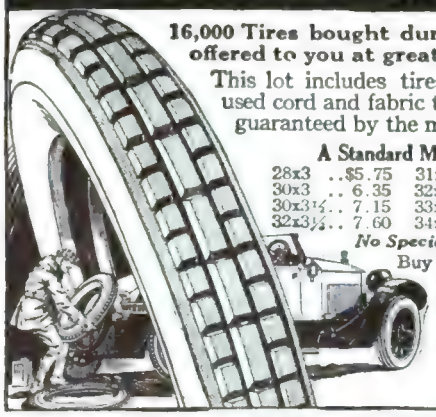
Gentlemen: Please send me full particulars of your Makafone Proposition, without obligation to me

Name .....

Address ..... State .....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

GUARANTEED MILLER MADE TUBE FREE



16,000 Tires bought during the recent tire panic and now offered to you at greatly reduced prices.

This lot includes tires that are rebuilt throughout, slightly used cord and fabric tires and reconstructed tires that were guaranteed by the manufacturers for 5,000 miles.

A Standard Make Tube Free with Each Tire Ordered

28x3 ..$5.75	31x4..$9.00	32x4½..$10.25	36x4½..$11.90
30x3 .. 6.35	32x4.. 9.10	33x4½.. 10.50	33x5 .. 12.00
30x3½.. 7.15	33x4.. 9.50	34x4½.. 10.70	35x5 .. 12.25
32x3½.. 7.60	34x4.. 9.75	35x4½.. 11.40	37x5 .. 12.75

No Special Discounts to Dealers or Agents

Buy your summer tires now. *Order today and save money.* State straight side or clincher. Send $2 deposit with your order and tire will be shipped balance C. O. D. Orders will be filled promptly until our limited supply is gone, so order today, before it is too late.

Chicago Tire Sales Company
96 Vincennes and 39th St. Chicago

AGENTS 500% PROFIT

Gold and Silver Sign Letters

For store fronts, office windows and glass signs of all kinds. No experience necessary. Anyone can put them on and make money right from the start.

$75 to $200 a Week!

You can sell to near-by trade or travel all over the country. There is a big demand for window lettering in every town. Send for free samples and particulars.

Liberal Offer to General Agents

METALLIC LETTER CO.
433Y No. Clark St. CHICAGO, ILL.

Send for a Copy of Our Manual of Wireless Telegraphy

We now have ready for distribution our Manual of Wireless Telegraphy. It contains 200 pages, fully illustrating and describing the many instruments used in Radio. 45 pages cover general instructions, diagrams, station calls, tables, codes and other information identified with the art.

The book is printed on high finished paper with a two-color cover and measures 9x5¾ inches.

Due to the scarcity of paper, the high cost of publication, and in order that the Manual may get into the hands of those most interested in Wireless, we ask 25 cents for it, give a coupon receipt for the amount, which coupon can be applied on a future purchase.

Get Your Copy Before the Edition Is Exhausted

MANHATTAN ELECTRICAL SUPPLY CO. INC.

17 Park Place, New York — 114 S. Wells St., Chicago — 1106 Pine St., St. Louis — 604 Mission St., San Francisco

SEND NO MONEY

ALL STANDARD MAKES

These tires are all standard makes, formerly guaranteed for 6,000 to 8,000 miles, many practically new. Do not confuse these exceptional **high grade tires with sewed or half soled tires. Thousands of users are getting 6,000 to 8,000 miles easy. Every tire we ship is backed by our satisfaction guarantee.**

SIZE	TIRES	TUBES	SIZE	TIRES	TUBES	SIZE	TIRES	TUBES
30x3	$ 6.95	$1.75	33x4	$11.25	$2.50	35x4½	$13.90	$3.15
30x3½	7.95	1.95	34x4	11.90	2.60	36x4½	14.50	3.40
32x3½	8.75	2.15	32x4½	12.25	2.70	35x5	14.90	3.50
31x4	9.45	2.25	33x4½	12.90	2.85	37x5	15.00	3.75
32x4	10.90	2.40	34x4½	13.25	3.00	36x4	15.90	4.00

No money in advance. We ship on approval by Express. See and inspect before you pay. 5 per cent discount if money in full accompanies order. Just write, tell us your size, also whether S.S. or C.L. **Send today.** While these bargain prices last.

KLASS-WORTH CO., 3033 Michigan Ave., Dept. 81 Chicago, Ill.

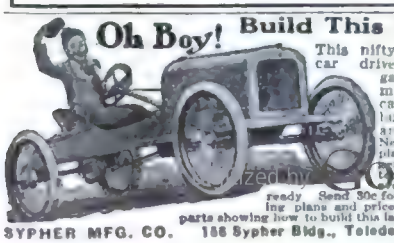
UTTMARK'S NAUTICAL ACADEMY RADIO SCHOOL

Offers a thorough course in all branches of wireless telegraphy. Radio Operators earn at the start $125.00 per month, and first-class board, etc., free.

Our school prepares you for your license in three to four months. Positions guaranteed to first-grade licensed operators.

Day and Evening Classes

8 State Street, New York, N. Y.
Phone, Bowling Green 8079



Oh Boy! Build This Car

This nifty little car driven by gasoline motor can be built by any boy. New 1921 plans, big 9x12 sheet, shows ready. Send 30c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO. 188 Sypher Bldg., Toledo, Ohio

MATHEMATICS MADE EASY

The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Long Distance Postpaid. Order today before you forget.

Dept. J, L. J. LEISHMAN CO., Ogden, Utah

former president of the United States was elected president of the World Congress. But he also represented the United States.

The reason for the disappearance of war, we are led to believe, was the potential power held by the United States. When the Great War came to an end in 1918, many new and terrible inventions were just nearing completion, and were perfected too late to be used in actual warfare. The possession of these secrets by the United States constituted an effectual curb to the aggressive instincts of any nation inclined to war.

One of the most spectacular inventions resulting from Signa Beth's discovery was that of Thomas Soddy's space navigating apparatus in 1938. By utilization of the terrific recoil developed in a certain method of disintegration, this instrument was able to leave the earth's surface like a sky rocket and travel beyond its gravitational orbit in any direction, at a tremendous rate of speed.

The effect of this invention upon the lay mind at that time can hardly be imagined. Nineteen years before, powerful waves of mysterious but undoubtedly ethereal origin had been received by some of the larger radio stations. The scientific explanations and press exploitations of these unidentified waves created such widespread excitement at the time that when Soddy returned from his epoch-making explorations of Mars and Venus in 1938, and confirmed these attempted Martian communications of 1919, and testified as to the residence on Mars and Venus of highly civilized beings, the people of the earth became wildly excited.

Results followed speedily. Intercourse between the inhabited planets of our solar system was quickly established. Interplanetary laws governing spacial navigation were quickly formulated and ratified, so that today we witness our great interplanetary merchant marine, touching all planets in the solar system, and many of the nearer stars. Trips of exploration are bringing in reports of new discoveries every day. Excursion ships dash thru space at regular hours, bound for other planets.

Soddy's invention truly marks the beginning of this Utopian era of Science. Mankind began to live a life of ease and indulgence, yet governed by sobriety and health.

Due to the congestion of our cities, some of which had a population of fifty-five millions, and to existing agricultural conditions, it was increasingly difficult, during the early sixties, to furnish enough food. The great Browning's discovery of a method permitting the direct conversion of heat into electricity enabled engineers of the period to solve this problem adequately. Thirty-foot tubes were excavated thru the earth's diameter, reaching from a large industrial center on one side to some extensive agricultural area upon the other. Africa, China, Australia, and parts of South America were touched. As these tubes were sunk, they were lined with Browning's electro-heat converting apparatus, which turned the intense heat of the bowels of the earth into an immense voltage, giving an electric current, but left the interiors of the tubes relatively cool and insulated from the fiery medium thru which they passed.

Food, produced easily and in large quantities in the farming countries, was quickly hauled over extensive railroad systems to the mouths of the tubes, and regular consignments dropped thru in specially designed cars. The momentum gained in the four thousand mile drop

Build and Fly Your Own
MODEL AEROPLANE!

Any bright boy can build an IDEAL Model of a real Aeroplane and learn lots about big machines.
It will fly in the air under its own power.
Complete Parts to construct an IDEAL 3-ft. Scale Model of the famous JN4D-2 (shown above), including Plans and Building and Flying Instructions.....$8.00
Ask Your Dealer or Order Direct
Plans and Instructions *only*, with catalogue of Parts needed, postpaid.....25c.
Catalogue alone, listing many other types of Model Aeroplanes, Parts and Supplies, postpaid.....5c.
IDEAL AIRPLANE & SUPPLY COMPANY
Making Model Aeroplanes Continuously for 10 years
159-161 Wooster St., Cor. West Houston St., N.Y.

HB Small Cash Payment Starts You Making Big Profits Charging Batteries

Get an HB Charger—*NOW!*
For only a small cash payment you can get an H. B. Battery Charger, and make from $1500 to $3000 *clear cash profits!* Almost a year to pay balance on easy monthly terms, easily carried by monthly profits. Sizes to charge 10, 16, 32 or 70 batteries. 10 days' free trial on absolute money-back guarantee. Choose size you need—then write *today* for information.
Hobart Bros. Co.
Box 47E, Troy, O.
Successful Manufacturers Since 1893.
You Can Clear $150 to $300 Monthly

1921 Model Warranted Watch $2.95
to introduce our watches. Thin model, beautifully polished silveroid case. Men's and women's size. Fitted with high grade movement, fully tested. Stem set and stem wind.
EVERY WATCH GUARANTEED
$2.95

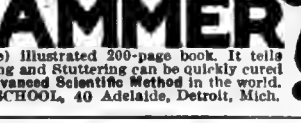
C.O.D.
Send us your name and address plainly written at once. We'll send this beautiful watch by return parcel post. Pay postman only $2.95. Test this 1921 timekeeper in every way. If not satisfied return it. We'll refund your money. Send your order TODAY.
Cambridge Watch Co., 350 Cambridge Bldg., Chicago, Ill.

Electrical men with training are in demand. For more than a quarter of a century this school has been training men of ambition and limited time for the electrical industries. Condensed course in Electrical **Engineering** enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics. Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete
In One Year

Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 29th year opens Sept. 28, 1921.
BLISS ELECTRICAL SCHOOL
315 TAKOMA AVE., WASHINGTON, D. C.

Why continue to
STAMMER?
Send for (free) illustrated 200-page book. It tells how Stammering and Stuttering can be quickly cured by the most **Advanced Scientific Method** in the world.
THE LEWIS SCHOOL, 40 Adelaide, Detroit, Mich.

FREE



TRIAL
Let us send this fine Razor for 30 days free trial. When satisfied after using, send $1.85 or return razor. Order Today. JONES MFG. CO., 106 W. Lake St. Dept. 906 CHICAGO

Be an Artist
Comics, Cartoons, Commercial, Newspaper and Magazine Illustrating, Pastel Crayon Portraits and Fashions. By Mail or Local Classes. Write for terms and List of successful graduates.
Associated Art Studies, 111 Flatiron Bldg. New York

easily carried the cars past the center of the earth, where gravity began to exert its counterpull, up to within several feet of the opposite surface. The moment they started to fall back, they were caught and held by automatic catches. Giant electric hoists completed their journey to the surface.

It is to these great engineering feats that credit must be given for the comfort of our modern city life. They may easily be regarded as among the most beneficial gifts to mankind that science has produced in the last four decades, for they make possible our present-day existence. Today we are so dependent for food upon these earth-piercing tubes, that if they all should be damaged simultaneously, there would be much suffering and hardship before repairs could be effected. Possibly many deaths might result from starvation. These tubes are indeed the arteries of our daily existence.

Some of the most widely known of Science's improvements have been those of transportation and travel. Speed, as demanded by the ease and luxury-loving internationalite of today, has been furnished by the prolific genius of science. Huge liners of the air, several thousands of feet in length, inflated with helium gas (which is a plentiful end-product of the disintegration processes), driven by powerful atomic engines at several hundred miles per hour, and luxuriously fitted with accommodations for at least a thousand passengers, ply the great Atlantic and Pacific between breakfast time and dinner. Our skies today are filled with wings swiftly propelled by noiseless thorio-actinic motors. Since the helium-filled ship came into general use, more than forty-five years ago, not a life has been lost in aerial transportation. Certainly this is a magnificent record, and a worthy tribute to the science that made it possible.

Progress in Education has been no less rapid. Today we have our great university cities, endowed by a benevolent government, for the free use of all mankind. Free higher-education to any who desire is as much a right of the world citizen of today as liberty was of the American of a century ago. Thousands of investigators in pure science now finish their education in the immense national universities of Mars and Venus, as all learning went to Europe to receive its degree in 1900.

In biology, geology, bacteriology, zŏology, engineering, chemistry, and all branches of science there has been rapid advancement. In biology, I understand, the synthetic production of living organisms has been lately accomplished, and promises wonderful achievements. It is no great flight of fancy to say that if we were able one billion years from now to look upon those warm, steamy, cooling, and still lifeless planets, where our interpid space-fliers have recently placed cultures of synthetic Amoeba, we might hope to see a creature occupying a place in that planetary existence comparable to that now filled by the earth's human race.

In medical science there has been such progress that death by sickness and disease is rare, whereas continued pain is hardly known, and certainly avoidable. By observing scientific methods of right living and obeying natural laws, one may expect to live for more than one hundred years. That is a period of existence nearly twice that of the average man fifty years ago.

Gentlemen, I ask you, can the coming century be filled with such an array of achievements? Possibly. Who can tell? Biology holds hopes which some of us may live to see realized.

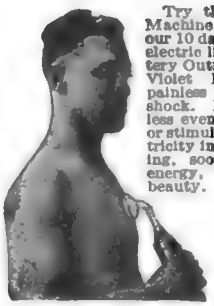
A BOOK ON PERFECT HEALTH VIA VI-REX VIOLET RAYS
FREE
Amazing New Vitality—Health Can Be Yours

New Kind of Electricity Brings Wonderful Beauty and Health
At last! Electricity in its greatest form for the human system.
Wonderful new Violet Ray treatments endorsed by physicians, beauty specialists, hospitals, osteopaths, and thousands of home users. Like a Godsend to sufferers. Like a beauty specialist for making poor complexions beautiful.

VI-REX Violet Rays

Better than gallons of liniment and drugs. Better than a ton of cosmetics. Violet Ray treatments now used at home by thousands. Remarkable records made in cases of **neuritis, rheumatism, asthma, catarrh, deafness, insomnia, obesity, nervousness, lumbago, pains, as well as in cases of skin troubles, sallowness, pimples, blackheads, falling hair.**

10 Days' Trial FREE



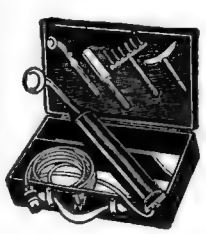
Try the Vi-Rex Violet Ray Machine in your own home on our 10 day offer. Attach to any electric light socket or use Battery Outfit Complete. See how Violet Rays are absolutely painless and harmless. No shock. No vibration. Harmless even to infants. Soothing or stimulating as desired. Electricity in its most helpful, healing, soothing form. Creates energy, strength, vigor and beauty. Write for offer.

Send No Money

Do not send money now. Just write postal or mail coupon for wonderful free 52 Page Book explaining in detail. Read how Violet Rays massage every cell in the body. Read letters from users. See what physicians, sanitariums, home users say.

WRITE NOW!

Why suffer? Why be satisfied with less than your full share of super health and beauty? See what wonderful Violet Rays will do for you. Mail coupon or write postal for free book and 10 days' Trial Offer. Do not miss this offer. Address NOW



VI-REX ELECTRIC CO.
Dept. 43
326 W. Madison St.
Chicago, Ill.

VI-REX ELECTRIC CO., Dept. 43
326 W. Madison St.
Chicago, Ill.

Please send me your free book and particulars of your Trial Offer of the Vi-Rex Violet Ray Machine.

Name.....
Address.....

Digitized by Google UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Opportunity Ad-lets

Advertisements in this section twelve cents a word for each insertion. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the June issue must reach us not later than April 22.

The Circulation of Science and Invention is over 140,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 236 Fulton Street, New York City, N. Y.

Aeronautics

Boys fly this model aeroplane. Circular free. Aero Shop, 3050 Hurlbut Ave., Detroit, Mich.

Send for the most remarkable flying novelty ever created. Attains a height from 50 to 100 feet, 25 cents. S. P. Lux, 1582 Pitkin Ave., Brooklyn, N. Y.

Aviation

Learn to Fly. America's oldest and most reliable Flying School. Complete Ground and Flying Instruction. We guarantee to make you an expert Pilot. Third Successful Season. Dozens of satisfied graduates. Classes begin the first of each month. Write now for Literature and Catalogue. The Ralph C. Diggins Co., 140 N. Dearborn St., Chicago, Ill.

Auto Accessories

Blueprints. Automobile Armatures. See ad under "Electrical." Charles Chittenden.

Storage Batteries for Automobiles. We furnish all parts and Moulds for making them. Sample Plate 40c. Foreign Countries 50c. Windsor Specialty Co., 5419 Windsor Ave., Chicago, Ill.

Tire Agents. Exclusive representatives to use and sell the new Mellinger Extra-Ply Tires. (No seconds.) Guaranteed Bond 8,000 Miles. Wholesale Prices. Sample sections furnished. Mellinger Tire Co., 980 Oak, Kansas City, Missouri.

Foul Proof Spark Plugs. Mechanics make Foul Proof Spark Plugs. Absolutely will not foul up. New Idea. Complete Instructions $2. Sample Plug $4. Mechanics Supply Co., Kansas City, Mo., Gateway Station.

Auto Motors Supplies. Buick, Michigan, Stoddard-Dayton, E. M. F. Cadillac, Overland, Continental and Buda Motors. All Types $50 each and up. Special High Tension Magnetos 2 and 4 cylinder $9.50 each. Electric and Gas Head Lamps, Coils, Carburetors, Air Compressors, Generators, Starters, etc. Write for Catalog. Address Motor Sales Dept. 12, West End, Pittsburgh, Penna.

How to make automobile storage battery plates. $1.00 postpaid. H. Deckelman, 7118 Nashville Ave., St. Louis, Mo.

We pay $50 a week taking orders for INSYDE TYRES inner armor for automobile tires. Guaranteed to give double tire mileage. Any tire. Prevents punctures and blowouts. Big demand. Low priced. Write quick for territory. American Accessories Co., B384, Cincinnati, Ohio.

Fords start easy in cold weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene, using our 1921 carburetors. Increased power; styles for all motors; can attach them yourself. Big profits to agents; money back guarantee; 30 days trial. Air Friction Carburetor Co., 1511 Madison St., Dayton, Ohio.

Battery Charging Outfits, all sizes. Absolutely new. Easy monthly terms. Hobart Bros., Troy, Ohio.

Motors, Engines and Dynamos

Special Garage Motors. New, manufactured by General Electric Co. ¼ HP $22.75; 1 HP $88.50; 2 HP $126.50; 3 HP $146.50; 5 HP $188.50. All sizes both single and Polyphase Motors for immediate delivery. Special charging generators all voltages. Write for catalogue. Motor Sales Dept. 12, West End, Pittsburgh, Penna.

Build an Electric Motor. Complete Outfit $2.00. Blue Prints 25c. A. F. Cassell, Box 355, Oradell, N. J.

Motor Bargain. Diehl 1/20 HP Universal 110 V. with pulley. Never used. Price $6.75 prepaid. Alsop Engineering Co., 200 W. 72nd St., N. Y.

Motors, farm lighting generators, battery chargers, new lower prices. Easy monthly terms. Hobart Bros., Troy, Ohio.

Motorcycles, Bicycles

Used Parts for all Motorcycles. Schuck Cycle Co., 1922 Westlake, Seattle, Wash.

Don't Buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 1604, Galesburg, Kans.

Machinery & Tools

Castings and drawings to build sensitive drill press, $10 per set. Particulars of reconstr... Swanson, 7826 Coles Ave., Chicago.

American Made Toys

Manufacturers wanted for larger productions and homeworkers on smaller scale for Metal Toys and Novelties, Toy Soldiers, Cannons, Cowboys, Indians, Buffalo Bills, Wild Animals, Whistles, Bird Whistles, Race Horses, Prize Fighters, Religious Statuettes, Puzzles and hundred of other Toys and Novelties. Hundred and more made complete per hour. No experience or tools needed. Bronze Casting forms with complete outfit from $5.00 up. We are buyers of these goods all year, paying fixed prices. Contract orders placed with manufacturers. Exceptional high prices paid for painted goods. An enormous business offers industrious men an excellent opportunity to enter this field. An open market for these goods all over United States, Canada and South America. Write us only, if you mean business. Illustrated catalogue and Booklet mailed free. Toy Soldier Manufacturing Company, Offices and Showrooms. 1696 Boston Road, New York.

Agents Wanted

Agents. Go into permanent business. No capital required. Should net $2,500 to $5,000 first year. Guaranteed products needed in every home. Repeat sales—big profits. Old established concern—products known everywhere. Many make sales of $30 to $50 per day. Practical sales helps, advertising matter furnished. Write today. W. T. Rawleigh Co., 345 Liberty St., Freeport, Ill.

Newest Thing Out. Lithogram initials for automobiles, motorcycles, canoes, golf sticks, tennis racquets etc. Anyone can apply them in a jiffy. Sell to everybody. Set costs 15c.; brings $1.50. Fast sales and big daily profits for agents. Write for catalog. Lithogram Company, Desk 19, East Orange, N. J.

Agents. Sell our accident and sickness policies in your spare time. Pay $5,000 death, $25 weekly benefit. Premium $10 yearly. Permanent income from renewals. Easy seller. Liberal commissions. Insurance Co., Dept. N-5, Newark, N. J.

Perfume Blocks sell everywhere. One Block costing fifty cents, perfumes an entire room for two months. 100% profit. Territory protection. Box 174A, Cleveland, Ohio.

Agents. Our soap and toilet article plan is a wonder; get our free sample case offer. Ho-Ro-Co., 138 Locust, St. Louis.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Agents. Here's the best line of Food Flavors, Perfumes, Soaps, Toilet Preparations, etc., ever offered. No capital needed. Complete outfits furnished Free to workers. Write today for full particulars. American Products Co., 2562 American Bldg., Cincinnati, Ohio.

Signs for Stores and Offices. Entirely new. $50 week easily made. Assorted working samples 25c. Chicago Sign System, E. 326 River St., Chicago, Ill.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Make Big Money. Sell Soldering Solution. No acid. Better than paste. Sample 25c. F. Kossatz, 5th Ave., New Rochelle, N. Y.

Agents. $60 to $200 a week. Free Samples. Gold Sign Letters for Store and Office windows. Anyone can do it. Big demand. Liberal offer to general agents. Metallic Letter Co., 433Z N. Clark St., Chicago, Ill.

Beginners complete Mail Order System. EX. Box 1005, Atlantic City.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Make $30.75 Profit on $2.50 Outfit. Gold Transfer Monograms for Automobiles, etc. Free Samples. National P. O. Box 6-E, Station D, Brooklyn, New York.

Salesmen Wanted

Salesmen. Earn $3,500 to $10,000 a year. City or Traveling. Experience unnecessary. Quickly qualify through our amazing system. Free employment service to members. Send for Salesmanship book, list of lines and full particulars. Nat. Salesmen's Training Ass'n, Dept. ...&D, Chicago, Ill.

Help Wanted

Universal Shorthand Course (Pitman) makes stenographic experts in 36 lessons. Efficiency guaranteed or money back. Helps users of other systems increase pay. Easy terms. Write for Booklet 12. Universal Shorthand Course, 6609 Kimbark Avenue, Chicago, Ill.

Stop Daily Grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 48, Marion, Indiana.

Detectives in Great Demand. Men from 18 to 45. Experience unnecessary. Easily learned. Write Earl H. Wilcox, Dept. A, 232 Sheldon Avenue, Grand Rapids, Mich.

Become Automobile Experts. Hundreds wanted. $35 week. Learn while earning. Write Franklin Institute, Dept. J, 806 Rochester, N. Y.

Earn $250 a month, expenses paid as RAILway Traffic Inspector outdoors. Local or traveling. Start at $110 monthly, position guaranteed after 3 months' spare time study. Write for Free Booklet G-57 Stand. Business Training Inst., Buffalo, N. Y.

Hundreds Permanent U. S. Government positions open to men—women—girls, over 17. Commence $135 month. Raise to $190 month. Vacation with full pay. Steady. No layoffs. Inside or outside work. Common education sufficient. Pull unnecessary. Experience unnecessary. List of positions open sent free. Write immediately. Franklin Institute, Dept. J 25, Rochester, N. Y.

Silvering Mirrors, French Plate Taught. Easy to learn, immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

How to Obtain the Position You Want. Remarkable Suggestions! Powerful Letters! $1.00. J. T. O'Neill, 1411 Thomas St., St. Paul, Minn.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Boys—Men! Become Auto Experts. $35 week. Learn while earning. Write Franklin Institute, Dept. H 806, Rochester, N. Y.

Men Wanted for Detective Work. Experience unnecessary. Write J. Ganor, former U. S. Gov't. Detective, 135 St. Louis.

Be a Mirror Expert. $3 to $10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Detectives earn big money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

Men Wanted at $35 to $100 a week to make mechanical drawings. Work is easy, pleasant, and leads to higher positions in Industrial Field at excellent salaries. We furnish set of instruments, train you at home, in spare time, by practical method and help you qualify for position. Write today for particulars. Roy C. Claflin, Pres., Dept. 1368, 14th & T Sts., Washington, D. C.

Be a Detective. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. Write American School of Criminology, Dept. B, Detroit, Mich.

Business Opportunities

Texas Land $6.00 Per Acre. We offer for immediate sale, in tracts of ten, twenty, forty and eighty acres each, patented land, full mineral rights and oil royalty included, located near a railroad in Brewster County, Texas. Warranty deed and opinion by reputable attorney approving the title, furnished with every tract. References: Dunn or Bradstreet, also State National Bank, San Antonio, Texas. H. J. McMullen, Bedell Building, San Antonio, Texas.

If you want to sell or exchange your farm, unimproved land, city property or patent, write me. John J. Black, 194th St., Chippewa Falls, Wis.

We Pay Cash for your spare time. Big money. Easy work. Guaranteed. Wonderful Proposition. Only $1.00 Retail. Standard Safety Razor Corporation, Pittsburgh, Pa.

Advertising, newspapers, magazines, everywhere. We prepare your advertisements, illustrations, form letters, circulars, booklets. Facilities for securing mail or store sales. Information cheerfully given; no charge. Write for catalog. Scott & Scott Advertising Agency, 25 W. 42nd St., New York.

(Continued on page 1365)

Digitized by Google Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

El Paso, Texas, Oct. 1, 1917.

MR. CHARLES F. HAANEL, St. Louis, Mo.

In Re "The Master Key."

My dear Mr. Haanel: The value of an idea is determined by its application. Pragmatism has long since spread beyond the confines of Missouri. The world to-day insists on being shown.

The lash of circumstances and the logic of events are, more than ever, impelling men to think. Whether an idea be a new process for picking cabbages or an old process (Kaiserism, for instance) for preserving kings, we are from Missouri.

A philosophy of life having as its base blind optimism; a religion that won't work seven days a week, or a proposition that isn't practical, appeals to the intelligent not at all. It is results that we want and the acid test is, will it work?

The Master Key qualifies. It is the most lucidly scientific statement of "Truth" that I have seen. It reconciles rationalism and religion; illumines economic determinism and the materialistic conception of history, and is an infallible guide to understanding. It contains in condensed form the substance of an entire library on science. Its teaching, if consistently applied, will make a man healthy, wealthy and wise. Its distribution is supermissionary work in excelsis. Those who wish to think intelligently will find it invaluable.

Intelligence rules. Desire intelligently directed is a creative force which automatically causes its object to manifest on a material plane. It is the law. Let him that hath an ear to hear, hear.

Yours truly,
CHAS. A. HEARD.

May 15, 1918.

Dear Mr. Haanel: Ever since I have been old enough to read, I have been reading metaphysical literature. I have waded ears deep through the books from all ages, all lands, all schools.

I have rejected tons of lies, oceans of misconceptions, an entire universe of false deductions. I have found grains of truth in mines of folly, and words of truth in a single grain. The pursuit was interesting in itself, and I do not regret the time spent upon it. But it was a genuine surprise to read your Master Key System and find within, the essence of all that I had read, with much more added thereto.

In this extraordinary system you have sifted the true from the false; you have given in concrete form all that is worth while in many schools of philosophy.

You have placed arcane truths into the hands of the uninitiated as weapons they can learn to use without danger to themselves. I congratulate you. You are doing mankind a service.

Yours very sincerely,
CHARLES F. OURSLER.

501 Fifth Avenue, New York City, N. Y.

Detroit, Mich., May 28, 1917.

Dear Sir: The words, "Your world will change as if by magic, the moment you realize the marvelous power within your control," page 6, I have underlined. They state a fact, a real live fact; and to me this is the most wonderful, the most important fact of all—that one may put this knowledge to an immediate test, that one may, after learning of this power, proceed to apply it with a definite knowledge as to results.

W. M. HOWE.

THE LOWE OBSERVATORY
Edgar Lucien Larkin, Director

Los Angeles, Cal., Dec. 6, 1916.

MR. CHAS. F. HAANEL, St. Louis, Mo.

Dear Sir: Your booklet, Master Key, ought to be expanded into a book. Its teachings that Mind is the all-dominating creative force is precisely in line with the wonders of the most recent psychology. All persons having desks should have this pamphlet thereon. And it would be a fitting pocket companion.

EDGAR LUCIEN LARKIN.

WHICH can unlock the secret chambers of success; can throw wide the doors which seem to bar men from the treasure house of nature, and bids those enter and partake who are wise enough to understand and broad enough to weigh the evidence; firm enough to follow their own judgment and strong enough to make the sacrifice exacted.

Chattanooga, Tenn., Feb. 22, 1918.

The Master Key is wonderful, it has brought about a most remarkable change in my environment, attitude toward life, mental and physical condition. I am an entirely new person and improving daily, discouragement, lack of ambition, physical ills, mental distress, and fear are things of the past

I cannot find words that express my gratitude for all that the Master Key has done for me. With heartfelt thanks to you, I am

Yours sincerely,
R. J. ARNOLD.

Washington, D. C., Dec. 29, 1916.

Dear Sir: Your little booklet entitled, "The Master Key," has been received and I had great pleasure in studying it carefully. It is a very clear and concise, yet forceful presentation of the big subject handled and shows a very wide study of the absolute teachings and deep understanding of the same.

Very truly yours,
JAMES LEE BOST.

"I am able to extract from this system all that can be made known by the finite mind relative to origin, evolution, destiny and the much-mooted riddle of the Universe."

"I can hardly grasp the full significance of the facts. The vastness of this subject is so overwhelming it seems a life-time of effort could never fathom all its possibilities.

"The Master Key is too modest a title for such a stupendous revelation."

"I have found the Key and with it each day am opening the store-house of wisdom and success, of which for many years I was utterly ignorant."

New York City, May 20, 1918.

Dear Mr. Haanel:

The Master Key system deals with the energy which creates things, rather than with the manipulation of things after they are created, because of this fact it is absolutely limitless.

Very sincerely,
E. FLOOD.

Charles F. Haanel, 203 Howard Bldg., St. Louis, Mo.

Send me the Master Key without cost or obligation of any kind.

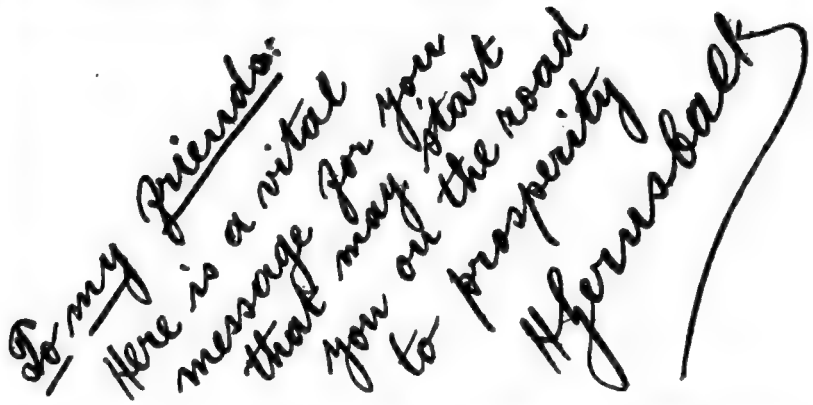
Name .....

Address .....

Post Office..... State .....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

NOTE—*Tomorrow, today will be yesterday.* Get your Master Key TODAY! NOW!



Your Savings Bank Pays You Only 4% Interest

We offer you an Investment that will pay you 7% and the chance of a Profit

You, who are readers of this magazine, know how the Experimenter Publishing Co. has grown during the past eight years. Three years ago we were publishing only one magazine, ELECTRICAL EXPERIMENTER (now known as SCIENCE AND INVENTION). This publication was only 72 pages with a very small circulation. Today it is one of the twenty-five largest monthly publications in the United States (in point of advertising carried)—every issue contains 104 to 120 pages and its circulation has increased to over 170,000 copies monthly.

RADIO NEWS was started only a year ago last July. You know the story of the growth of this magazine as well as we do. Today it is the greatest wireless magazine the world has ever known. Its circulation is larger than the total circulations of all the other radio magazines in the United States combined. RADIO NEWS carries by far more advertising each month than any other wireless magazine —in fact its advertising lineage is greater than many of the so-called big general magazines that you all read.

The Experimenter Publishing Company has made money consistently year after year. The surplus has been put back into the business to develop the property until today we have a business that has an annual turnover of two-thirds of a million dollars. And this was accomplished on a very small and limited capitalization.

Last year, despite the terrific increases in the cost of paper, printing, art work, engravings, labor—in fact, everything—we showed a very substantial net profit. The net profits for the year 1920 amounted to over $42,000. Now with costs coming down, we have the opportunity of making these two magazines the greatest of any class magazines in the country. We want to see SCIENCE AND INVENTION running over 200 pages every month—we want to see RADIO NEWS with 150 or more. We want to double the circulation so the advertising will be worth more to the advertisers allowing us to enlarge and improve the magazines still further. We want to place our two magazines beyond any competition whatsoever. And we can do it with a little more capital.

We Invite You to Become Our Partners

We will sell to our subscribers 1,000 shares only of 7% non-cumulative preferred stock of a par value of $100 per share. You can invest any amount you want from $100 up in multiples of one hundred. Every share of preferred stock pays guaranteed dividends of 7% yearly—nearly twice what you get from a savings bank. In addition, as the magazines grow and the company gets stronger and stronger each year, the stock becomes worth more and more. In this way you have the opportunity of making a safe, profitable investment and one with speculative possibilities as well.

If you can invest more than $500 let us show you how your money can earn about 10% interest instead of 7%. We have a special proposition for investments of $500 or over; write for it today.

If you do not wish to pay cash for your shares we offer our special installment plan—pay as you go along. Write us about this today.

You surely have some surplus funds available. Take advantage of this opportunity of investing them in a stock that combines safety, high yield, and the chance for a profit on the principal. Fill out the enclosed subscription blank for as many shares as you can carry and return today.

H. GERNSBACK, President

Experimenter Publishing Company

Established 1913

233 and 236 Fulton St. New York City

Application for Seven Per Cent Non-Cumulative Preferred Stock of the Experimenter Publishing Company

EXPERIMENTER PUBLISHING CO.,
233 Fulton St.,
New York, N. Y.

Gentlemen:—

Please accept my subscription for ..... shares of your 7% non-cumulative preferred stock at the par value of $100.00 each share. I enclose my check for $..... herewith.

Name .....

Address .....

City .....

State .....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Go as High as You Like

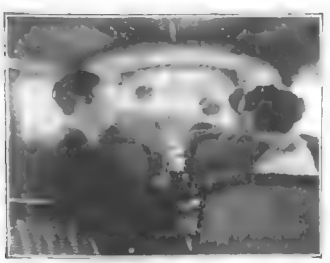
No Limit to Salaries in Aviation

No other industry offers the wonderful chances for big money-making that the Airplane Industry offers to ambitious men. Many more trained men will be needed to fill big paying jobs. The airplane has come to stay—it will soon be a part of our everyday life. The men who get in now are the ones that will cash in big. Look at the "big fellows" in the automobile game today. They represent power and wealth because they got in early—you can do the same in Aviation and you have an advantage because you can be trained before you start.

Delivering Newspaper "Extras" by Airplane

Thousands of Airplane Mechanics Will Be Needed

The airplane industry is going forward by leaps and bounds. Transportation—passenger carrying and mail carrying lines are being opened up everywhere. This means men—men—men! Trained men only are wanted—men who know what's what. Get ready now to make big money. The industry is calling for real red-blooded fellows—heed the call—*now* is the time to get started—while the industry is still in its infancy.



A New Seven-Passenger Airplane

Here Are a Few Jobs That Will Pay $50 to $250 a Week:

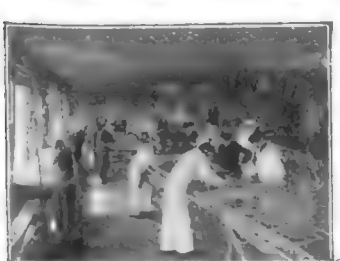
Aeronautical Instructor Aeronautical Engineer Aeronautical Contractor Airplane Repairman
Airplane Mechanician Airplane Inspector Airplane Salesman Airplane Assembler Airplane Builder

A New Job—The Aerial Postman

Learn at Home IN YOUR SPARE TIME

Keep right on with the work you are doing now. A little of your spare time is all you need. Our Special Course is simplified for home instruction and is endorsed by airplane manufacturers, aeronautical experts, aviators and the leading aero clubs. Any man that can read English can understand it. The Lessons are self-explanatory and are made plain as day with Blueprints, Diagrams, etc.

Our Advisory Council and Instructors are behind you all the time giving you everything you must know. The entire field of Practical Aeronautics and Science of Aviation is laid right before your eyes. You are bound to succeed with this training. This means for you a man's size job with a man's size pay.



View in an Airplane Factory

Big Book of Opportunities FREE!

Send for our big free book showing just what is going on in the Airplane Industry. It also shows what other men have done in this fascinating field and what you can do, too. It gives a list of some large manufacturers and dealers in airplanes and some of the jobs that are open to trained men. With the book we will send you a special offer that you will be glad to know about. This special offer may be withdrawn at any time without notice. *Send the coupon now and take advantage of this offer.*

Mail This Coupon For FREE BOOK

AMERICAN SCHOOL OF AVIATION
Dept. 7444
3601 Michigan Ave., Chicago, Ill.

Without obligation on my part you may send me your book entitled "Opportunities in the Airplane Industry" and your SPECIAL Limited offer.

Name_____

Address_____

City_____ State_____

American School of Aviation
Dept. 7444 3601 Michigan Ave. Chicago

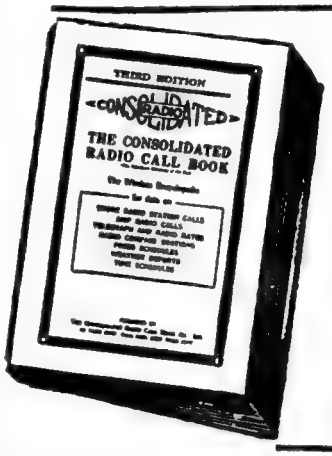
Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

The Third Edition of the

Consolidated Radio Call Book

Very Greatly Enlarged

192 pages. (32 pages more than 2nd edition,) better paper, stiff covers etc.



Some of the special information contained in the new book: Radio rate sheet (charges to and from vessels, etc.); Cable rates; Table for finding cable charges to various points; Weather reports and hydrographic reports of the world; Time signal section of the world; American radio compass stations; French radio compass stations; British radio compass stations; Canadian radio compass stations; General information section; International abbreviations; High power radio stations of the world; Press schedules of spark stations.

The Consolidated Radio Call Book is the only book in print officially listing all the Radio calls as issued by the Bureau of Commerce. Every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.

Every New Amateur Call Is Listed

SPECIAL—Given Free with Each Copy

A Wireless Map of the World **in colors** is given absolutely free with each copy. This map shows the locations of all the high powered RADIO stations in the world, including the time signal stations. In addition it tells at a glance how far away any of these stations are. Of greater interest are the time zones, which enable the amateur to compute instantly the correct time for the zone in which he is located from any time signal station.

The second edition of 10,000 copies was exhausted in ten days. The third edition is selling just as quickly. Don't wait until it is all gone. Order at once, either direct from us or from your favorite dealer.

Price $1.50 Prepaid

Order Direct from us or for sale by the following responsible Dealers:

American Electro Tech. Appliance Co., New York City
American Hardware Stores, Bridgeport, Conn
Atlantic Radio Co., Boston, Mass.
Bamberger & Co., L., Newark, N. J.
Benwood Specialty Co., St. Louis, Mo.
Brode Electric Co. Los Angeles, Cal.
Bunnell & Co., J. H. New York City
California Electric Co., San Francisco, Cal.
Catton, Neill & Co., Honolulu, T. H.
Central Radio Co. Independence, Mo.
Chicago Radio Apparatus Co., Chicago, Ill.
Continental Radio & Electric Corp., New York City
Cutting & Washington Radio Corp., New York City
Detroit Radio Laboratories, Detroit, Mich.
Dewey Sporting Goods Co., Milwaukee, Wis.
Doubleday-Hill Electric Co., Pittsburgh, Pa.
Electro Importing Co., New York City
Findley Electric Co., Minneapolis, Minn.
Fuller Co., Seth W., Boston, Mass.
Gurd & Co., Wm., London, Canada
Hico Wireless Supply Co., Marion, Ill.
Holt Electric Utilities Co., Jacksonville, Fla.
Jenkins, Lester I., New Bedford, Mass.
Katzenbach & Co., F. S., Trenton, N. J.
Kendall Co., W. D., Worcester, Mass.
Killoch Co., David, New York City
Kluge, Arno A., Los Angeles Cal.
Krause & Co. A. P. Detroit Mich.
Lehigh Radio Co. Bethlehem, Pa.
Linze Electrical Supply Co., St. Louis, Mo.
Manhattan Electric Supply Co., New York. Chicago
McCarthy Bros. & Ford, Buffalo, N. Y.
McClurg & Co., A. C., Chicago, Ill.
Meter Electrical Construction Co., Oshkosh, Wis.
Meyberg Co., Leo J., San Francisco, Cal.
Mohawk Electrical Supply Co., Syracuse, N. Y.
New Era Shop, Milwaukee, Wis.
Newman-Stern Co., Cleveland, Ohio
Nola Radio Co., New Orleans, La.
Noll & Co., E. P., Philadelphia, Pa.
Northwest Radio Service Co., Seattle, Wash.
N. S. W. Bookstall Co., Sydney, Australia
Pacent Electric Co., New York City
Paramount Radio Supply Co., Atlantic City, N. J.
Parks, Henry Francis, Butte, Mont.
Pearlman's Book Shop, Washington, D. C.
Penn Radio Apparatus Co., Reading, Pa.
Pennsylvania Marconi Wireless School, Philadelphia, Pa.
Philadelphia School of Wireless Telegraphy, Philadelphia, Pa.
Piedmont Electric Co., Asheville, N. C.
Pioneer Electric Co., St. Paul, Minn.
Pitts Co., F. D., Boston, Mass.
Post Office News Co., Chicago, Ill.
Precision Equipment Co., Cincinnati, Ohio
Radio Distributing Co., Newark, N. J.
Radio Electric Co., Pittsburgh, Pa.
Radio Equipment Co., Boston, Mass.
Radioelectric Shop, Cleveland, Ohio
Ray-Di-Co., Chicago, Ill.
Reuter Electric Co., Cincinnati, Ohio
Riverside Laboratory, Milwaukee, Wis.
Rose Radio Supply, New Orleans, La.
Saunders Co., Geo. S., Boston, Mass.
Schmidt & Co., Rudolph, Rochester, N. Y.
Sears, Roebuck & Co. Chicago, Ill.
Service Radio School Washington, D. C.
Shaffers', Norfolk, Va.
Shotton Radio Mfg. Co., Scranton, Pa.
Smith Bros. Sarnia, Ont., Canada
Smith Novotoy Electric, Inc., Charlotte, N. C.
Southern Electrical Supply Co., San Diego, Cal.
United Radio Telegraphers' Assoc., Baltimore, Md.
Western, Radio Electric Co., Los Angeles, Cal.
Whitall Electric Co., Westerly, R. I.
White & Boyer Co., Washington, D. C.
White Co., The Columbus, Ga.
Williamson Electric Co., H. E., Seattle, Wash.
Wilmington Electrical Specialty Co., Wilmington, Del.
Wireless Mfg. Co., Canton, Ohio
Wireless Press, New York City
Wireless Shop, Los Angeles, Cal.
Young & McCombs, Rock Island, Ill.
Young Men's Christian Assoc., Los Angeles, Cal.
Zamoiski Co., Jos. M., Baltimore, Md.

Published by

Consolidated Radio Call Book Co., Inc.

41 Park Row, New York City

Digitized by Google Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Worth $10,000 a Year and Didn't Know It

For Years Warren Hartle Worked for $18 a Week, Never Thinking He Could Make Much More. Today He is Earning $10,000 a Year! Read the Amazing Story of His Easy and Sudden Rise to Success

FOR ten years he worked in the Railway Mail Service at pay ranging from $900 to $1,600 a year—just bare existence wages, with no opportunity to make more or save. *And now he is earning $10,000 a year!* Yes, Warren Hartle makes as much some months now as he formerly did in a year's hard work on the railroad.

Hartle's sudden rise to real success may sound amazing, almost unbelievable, yet there is not the slightest doubt that you can do exactly what he did. What was the secret of his sudden rise from small pay to magnificent earnings? *It was the same secret that has brought prosperity to thousands of others.*

Another man I happen to know is J. P. Overstreet of Denison, Texas. A short time ago he was a police officer earning less than $1,000 a year. Now he writes: "My earnings for March were over $1,000, and over $1,800 for the last six weeks while last week my earnings were $356.00." G. W. Campbell, Greensburgh, Pa., was formerly a railroad employee on a small salary. In one month his earnings were $1,562. Then there is Charles L. Berry of Winterset, Iowa, who quit his job as a farm hand and earned $2,140 in one month.

Why Don't YOU Get Into The Big Money Field?

MR. HARTLE, Mr. Overstreet, Mr. Campbell and Mr. Berry are all successful Salesmen. They realized their ambition by landing $10,000 jobs in an amazingly simple way with the help and guidance of the National Salesmen's Training Association. Some time—somewhere back in the past each one of them read of this remarkable course of Salesmanship Training and Employment Service, just as you are reading of it today. Each one of them was dissatisfied with his earning capacity as perhaps you are—and each one cast his lot with the N. S. T. A. Today they are important factors in the business world—enjoying all the comforts and luxuries money can buy. And yet they are not exceptions, for there are thousands of N. S. T. A. Trained Salesmen who are making big money, as we will be only too glad to show you if you will mail the coupon below.

Why Salesmen Earn Such Big Pay

THE man who starts working as a bookkeeper or clerk for $25.00 a week, never increases his value to the firm. At the end of ten years he is no more essential to the life of the organization than he was at the end of ten weeks. He is only a necessary liability—drawing his pay because somebody must be found to work at the unimportant, routine jobs.

If you will study any business organization you will see that the big jobs go to the men who are in the Selling end, for upon their efforts depend the profits a company makes. Without trained men to place a product on the market, the finest goods are worth no more than so much clay. Salesmen are the very nerve centers of a business. Is it any wonder that they earn such big pay?

Secrets That Only Master Salesmen Know

FROM "greenhorn" to Master Salesman in next to no time sounds almost too good to be true. Yet we accomplish this wonderful transformation year after year because we teach the REAL SECRETS OF SALESMANSHIP. We take you through this fascinating subject step by step—teach you how to get an audience—how to open a sales talk in order to get the prospect's attention—how to make the prospect eager to get all the facts about your proposition—how to get him to act at once instead of putting you off—when to stop talking—and definite principles of overcoming every possible objection that may arise in the process of making a sale.

There are certain ways of doing and saying things in selling—the secrets that only Master Salesmen know—and once you have acquired the fundamental principles—once you are master of these Selling Secrets—your power of accumulating money is almost unlimited. The man who understands the underlying principles of Salesmanship has a two-fisted grip on prosperity. He can sell his services a hundred times over, for there is an enormous demand for his highly specialized knowledge.

We Train You and Help You Land a Job

THE National Salesmen's Training Association is an organization of top-notch Salesmen and Sales Managers formed for the express purpose of training men in the science of successful Selling. You do not need to know the first thing about Selling—you need not give up your present position until you are ready to begin actual Selling.

In addition, the N. S. T. A. maintains a Free Employment Service to help its members to positions in the lines for which they are best suited just as soon as they are qualified and ready.

Salesmen Are Needed—Now!

GET out of that rut. Work for yourself! Salesmanship is the biggest paid of all professions. We have made Master Salesmen of men from all walks of life, with no previous Selling experience. These men have jumped from small pay jobs to positions that pay real money. You can follow in their footsteps. Never before have the opportunities been greater. Investigate the great field of Selling and see what it offers you. The facts and proof you will receive will surprise you.

Send for Free Book on Salesmanship Now

JUST mail the coupon or write for our free illustrated Book, "A Knight of the Grip," which we will be glad to send without any obligation on your part. Let us prove to you that regardless of what you are doing now, you can quickly become a Master Salesman. Let us show you how you, too, can step into the ranks of these big money makers of business. See how easily you can learn this fascinating, big pay profession at home in your spare time. Learn what we have done for others and what we stand ready to do for you. Don't put it off a minute—write us now. Every day lost keeps you that much further from success. Mail the coupon at once.

National Salesmen's Training Association
Dept. 42-D, Chicago, Ill.

National Salesmen's Training Association
Dept. 42-D, Chicago, Ill.

Please send me without any obligation on my part, your free Book on Salesmanship and full information about the N. S. T. A. system of Salesmanship Training and Free Employment Service. Also a list showing lines of business with openings for salesmen.

Name .....

Street .....

City ..... State .....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

WANTED—FOR CASH

Used Radio Apparatus of all Standard Makes

Our used wireless apparatus department, connected with our local retail store at 233 Fulton Street, New York City, is anxious to buy any radio instruments you may have for sale. These goods are for our New York customers only—**we sell no used radio apparatus by mail.** But we do have a tremendous call at our store for fine class goods and we will be glad to hear from you if you have any that you would like to dispose of.

WE PAY CASH

for all such merchandise that we buy, and this is an invitation extended to the radio fraternity to sell us their radio apparatus for which they have no further use. Write us in your first letter what make apparatus you have to sell, and **your lowest spot cash price.** It must be understood that all transportation is to be paid for by you. All goods to be sent to us prepaid either by parcelpost, express, or freight.

We can use only standard apparatus, no obscure instruments or home-made apparatus can be considered in any event.

If you have friends who wish to dispose of such apparatus, show them this advertisement. Also please note that your letter must state in just what condition the instruments are and that no goods must be sent to us unless we send you a written order to do so.

We invite amateurs residing in New York or vicinity to call at our store and inspect the used radio apparatus which will be placed on sale shortly after this advertisement appears.

Address all letters

to Used Apparatus Department

ELECTRO IMPORTING COMPANY
(Established 1904)

231 Fulton Street **New York City**

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

How One Evening's Study Led to a $30,000 Job

A Simple Method of Mind Training That Any One Can Follow With Results from the First Day

By a Man Who Made Formerly No More Than a Decent Living

I HOPE you don't think I'm conceited or egotistical in trying to tell others how I suddenly changed from a comparative failure to what my friends term a phenomenal success.

In reality I do not take the credit to myself at all. It was all so simple that I believe any man can accomplish practically the same thing if he learns the secret, which he can do in a single evening. In fact, I know others who have done much better than I by following the same method.

It all came about in a rather odd manner. I had been worrying along in about the same way as the average man, thinking that I was doing my bit for the family by providing them with three square meals a day, when an old chum of mine, Frank Powers, whom I had always thought was about the same kind of a chap as I, suddenly blossomed out with every evidence of great prosperity.

He moved into a fine new house, bought a good car and began living in the style of a man of ample means. Naturally the first thing I did when I noticed these things—for he had said nothing to me about his sudden good fortune—was to congratulate him and ask him what had brought the evident change in his finances.

"Bill," he said, "it's all come so quickly I can hardly account for it myself. But the thing that has made such difference in my life lately began with an article I read a short time ago about training the mind.

"It compared the average person's mind to a leaky pail, losing its contents, as it went along, which if carried any distance would arrive at its destination practically empty.

"And it showed that instead of making the pail leak-proof most of us kept filling it up and then losing all we put into it before we ever reached the place where the contents would be of real use.

"The leak in the pail, the writer demonstrated, was forgetfulness. He showed that when memory fails, experience, the thing we all value most highly, is worthless. He proved to me that a man is only as good as his memory, and whatever progress a man accomplishes can be laid directly to his powers of retaining in his mind the right things—the things that are going to be useful to him as he goes along.

"Farther on in the article I read that the power of the mind is only the sum total of what we remember—that is, if we read a book and remember nothing that was in it, we have not added one particle to our experience; if we make a mistake and forget about it, we are apt to make the same mistake again, so our experience did not help us. And so on, in everything we do. Our judgment is absolutely dependent on our experience, and our experience is only as great as our power to remember.

"Well, I was convinced. My mind was a 'leaky pail.' I had never been able to remember a man's name thirty seconds after I'd been introduced to him, and as you know, I was always forgetting things that ought to be done. I had recognized it as a fault, but never thought of it as a definite barrier to business success. I started in at once to make my memory efficient, taking up a memory training course which claimed to improve a man's memory in one evening. What you call my good fortune to-day I attribute solely to my exchanging a 'leaky pail' for a mind that retains the things I want to remember."

* * * * *

Powers' story set me thinking. What kind of a memory did I have? It was much the same as that of other people I supposed. I had never worried about my memory one way or another, but it had always seemed to me that I remembered important things pretty well. Certainly it never occurred to me that it was possible or even desirable to improve it, as I assumed that a good memory was a sort of natural gift. Like most of us, when I wanted to remember something particularly I wrote it down on a memorandum pad or in a pocket notebook. Even then I would sometimes forget to look at my reminder. I had been embarrassed—as who has not been?—by being obliged to ask some man whom I had previously met what his name was, after vainly groping through my mind for it, so as to be able to introduce him to others. And I had had my name requested apologetically for the same purpose, so that I knew I was no different than most men in that way.

I began to observe myself more closely in my daily work. The frequency with which I had to refer to records or business papers concerning things that at some previous time had come under my particular notice amazed me. The men around me who were doing about the same work as myself were no different than I in this regard. And this thought gave new significance to the fact that I had been performing practically the same subordinate duties at exactly the same salary for some three years. I couldn't dodge the fact that my mind, as well as most other people's literally limped along on crutches, because it could not retain names, faces, facts, and figures. Could I expect to progress if even a small proportion of the important things I learned from day to day slipped away from me? The only value of most of my hard-won experience was being canceled—obliterated—by my constantly forgetting things that my experience had taught me.

The whole thing hit me pretty hard. I began to think about the subject from all angles as it affected our business. I realized that probably hundreds of sales have been lost because the salesman forgot some selling point that would have closed the order. Many of our men whom I had heard try to present a new idea or plan had failed to put over their message or to make a good impression because they had been unable to remember just what they wanted to say. Many decisions involving thousands of dollars had been made unwisely because the man responsible didn't remember all the facts bearing on the situation and thus used poor judgment. I know now that there isn't a day but what the average business man forgets to do from one to a dozen things that would have increased his profits. There are no greater words in the English language descriptive of business inefficiency than the two little words "I forgot."

I had reached my decision. On the recommendation of Powers, I got in touch at once with the Independent Corporation, which shortly before had published the David M. Roth Method of Memory Training. And then came the surprise of my life. In the very first lesson of the course I found the key to a good memory. Within thirty minutes after I had opened the book the secret that I had been in need of all my life was mine. Mr. Roth has boiled down the principles perfecting the memory so that the method can almost be grasped at a glance. And the farther you follow the method the more accurate and reliable your memory becomes. Within an hour I found that I could easily memorize a list of 100 words and call them off backward and forward without a mistake. I was thunderstruck with the ease of it all. Instead of study the whole thing seemed like a fascinating game. I discovered that the art of remembering had been reduced by Mr. Roth to the simplest method imaginable—it required almost nothing but to read the lessons! Every one of those seven simple lessons gave me new powers of memory, and I enjoyed the course so much that I look back on it now as a distinct pleasure.

The rest of my story is not an unusual one among American business men who have realized the value of a reliable trained memory. My income to-day is close to $30,000. It will reach that figure at the beginning of our next fiscal year. And two years ago I scarcely made what I now think of as a decent living.

In my progress I have found my improved memory to be priceless. Every experience, every business decision, every important name and face is easily and definitely recorded in my mind, and each remembered experience was of immense value in my rapid strides from one post to another. Of course I can never be thankful enough that I mended that "leaky pail" and discovered the enormous possibilities of a really good memory.

David M. Roth

When Mr. Roth first determined to exchange his leaky mind for one that would retain anything he wanted it to, it was because he found his memory to be probably poorer than that of any man he knew. He could not remember a man's name 20 seconds. He forgot so many things that he was convinced he could never succeed until he learned to remember. To-day there are over ten thousand people in the United States whom Mr. Roth has met at different times—most of them only once—whom he can instantly name on sight.

Mr. Roth can and has hundreds of times at dinners and lectures asked fifty or sixty men he has never met to tell him their names, businesses and telephone numbers and then after turning his back while they changed seats, has picked each one out by name, told him his telephone number and business connection. These are only a few of the scores of equally "impossible" things that Mr. Roth can do, and yet a few years ago he couldn't remember a man's name twenty seconds. Why go around with a mind like a leaky pail when, as Mr. Roth says, "what I have done any one can do."

SEND NO MONEY

Mr. Roth's fee for personal instruction to classes limited to fifty members is $1,000. But in order to secure nation-wide distribution for the Roth Memory Course in a single season the publishers have put the price at only five dollars, a lower figure than any course of its kind has ever been sold before, and it contains the very same material in permanent form as is given in the personal $1,000 course.

So confident is the Independent Corporation, the publishers of the Roth Memory Course, that once you have an opportunity to see in your own home how easy it is to double, yes triple the powers of your memory, and how easily you can acquire the secret of a good memory in one evening, that they are willing to send the Course on free examination.

Don't send any money. Merely mail the coupon or write a letter and the complete course will be sent, all charges prepaid, at once. If you are not entirely satisfied send it back any time within five days after you receive it and you will owe nothing.

On the other hand, if you are as pleased as are the thousands of other men and women who have used the course, send only $5 in full payment. You take no risk and you have everything to gain, so mail the coupon now before this remarkable offer is withdrawn.

Independent Corporation

Dept. R-1104, 319 Sixth Avenue New York

FREE EXAMINATION COUPON

Independent Corporation

Dept. R-1104, 319 Sixth Avenue New York

You may send me the Course or Courses checked below. Within five days after receipt I will either remail them or send you $5 for each in full payment.

☐ Roth Memory Course ($5) By David M. Roth

☐ Mastery of Speech ($5) By Frederick Houk Law

☐ Drawing, Art, Cartooning Course ($5) By Charles Lederer

☐ Super-Salesmanship ($5) By Arthur Newcomb

☐ How to Read Character at Sight ($5) By Dr. K. M. H. Blackford

☐ How to Write Stories By Prof. W. B. Pitkin

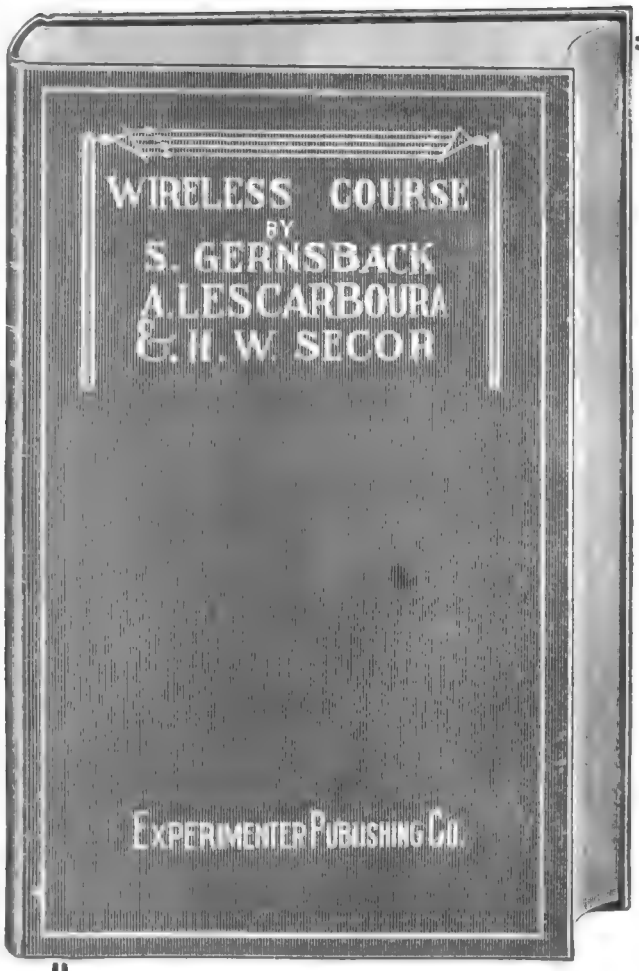
Name.....

Address.....

.....

Sc. & In. 4-21

Digitized by Google Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



Important Notice

JUST OFF PRESS:

10th Edition

of the well-known

WIRELESS COURSE

in 20 Lessons

By

S. GERNSBACK, H. W. SECOR,
A. LESCARBOURA

THIS Course has been considerably revised in order that it meet some of the many important changes which have occurred in Radio Telegraphy and Telephony within recent years. Much valuable data and illustrations concerning the Vacuum Tube has been added. This comprises the theory of the Tube as a detector and as an amplifier, and in addition has been included modern amplification circuits of practical worth. Incidentally, space has also been devoted to the development of the Radio Compass as operated and controlled by the United States Navy with its consequent great aid to present-day navigation.

The beginner and general student of radio will find this Course of great value in securing the necessary fundamentals of a most fascinating and instructive vocation, or avocation—as the case may be. Radio holds out considerable inducements as a career.

THE PUBLISHERS

Beautifully Bound
in Red Cloth
Gold Stamped
Size 7x10 inches
160 Pages
20 Lessons
360 Illustrations
30 Tables

Price $1.75

PREPAID

The Experimenter Publishing Co., Inc.

236 FULTON STREET
NEW YORK, N. Y.

THE EXPERIMENTER PUBLISHING CO., Inc.
236 Fulton Street, New York, N. Y.

Enclosed find $1.75 in ..... CHECK / M. O. for which send me one copy of 10th EDITION WIRELESS COURSE POSTPAID.

Name .....

Town .....

Address .....

State .....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Has This Ever Happened to You?

IF you were a guest at dinner and you overturned a cup of coffee, what would you do? What would you say? Would you turn to the hostess and say "I beg your pardon"? Would you offer your apologies to the entire company? Would you ignore the incident completely? Which is the correct thing to do?

To be able to do and say the right thing at the right time is the badge of culture, and the man or woman who has that power is indeed an individual of polish and poise.

What Do You Know About Introductions?

To establish an immediate and friendly understanding between two people who have never met before, to make the conversation flow more smoothly and pleasantly, to create an agreeable, harmonious atmosphere —that is the purpose of the *introduction*. A correct, courteous conversation-making introduction is an art itself, and reflects refinement and culture on the person who is the medium.

How do YOU introduce two people? Do your introductions create a pleasant, easy atmosphere, or one that is uncomfortably strained?

Try this simple test and see what you really know about the art of introduction:

Mrs. Brown and Miss Smith have met at your home for the first time. Would you say, *Mrs. Brown, meet Miss Smith*, or *Miss Smith, meet Mrs. Brown?* Would you say, *Miss Smith, let me make you acquainted with Mrs. Brown?*

If Mr. Blank happened to drop in for a little chat, how would you present him to the ladies: to both at once, or to each one individually? And how would you present Bobby, who comes running in from school; *Bobby, this is Mr. Blank*, or *Mr. Blank, this is Bobby*, or would you use the *I want you to meet* method? Do you ever say, *I take pleasure in introducing?* Is it right or wrong?

How do you introduce a sweetheart to your relatives for the first time? How do you introduce her or him to your friends?

On the other hand, if you are being introduced, how do you acknowledge it? Do you use any of these expressions: "*Pleased to know you*," "*Delighted*," "*How do you do?*" Does a gentleman rise upon being introduced to a lady? Does the lady rise? Is it correct for the lady and gentleman to shake hands?

The difference between the right and wrong thing in introducing is the difference between culture and coarseness.

The man who would be polished, impressive, and the woman who covets the wonderful gift of charm must cultivate the art of introduction.

Etiquette at the Dance

The ball-room should always be a center of culture and grace. To commit a breach of etiquette at the dance is to condemn yourself as a hopeless vulgarian. But alas! how many blunders are made by people who really believe that they are following the conventions of society to the highest letter of its law! What blunders do you make in the ball-room? These questions may help you discover them.

Does etiquette allow a woman to ask for a dance? May she refuse to dance without a reason? What is the proper thing for a young girl to do if she is not asked to dance? What is a polite and courteous way of refusing a dance? How many times may a girl dance with the same partner without breaking the rules of etiquette? Is it correct to wander away from the ball-room with a fiance?

According to etiquette's laws is it necessary for a gentleman to dispose of his partner to someone else before he asks another lady for a dance? How shall he ask a lady to dance? Which are the correct forms and which the incorrect? How shall he dispose of the lady after the dance if he must return to the lady he has escorted? What is the right dancing position for the gentleman? For the lady? What style of dress is correct to wear at a dance?

There is perhaps no better place to display the culture and finesse of your breeding than the ball-room, resplendent with the gay gowns of women and enchanting with the ease and gracefulness of dancing couples. Here the gallantry of true gentlemen and the grace and delicacy of cultured women asserts itself. Here you can distinguish yourself either as a person of culture or a person of boorishness.

When Wedding Bells Ring Out

etiquette again comes to the fore. What is the right dress for the bride to wear? How shall the invitations be worded? When shall the groom give his farewell bachelor dinner? How shall congratulations be extended? And after the wedding there are cards of thanks and cards of invitation to be sent. The wedding breakfast must be arranged and perhaps a honeymoon trip must be planned. Suffice to say, that the bride and bridegroom will find invaluable aid in the "Encyclopedia of Etiquette."

Encyclopedia of Etiquette

In Two Comprehensive Volumes

In the most minute details of daily life, in the hours of prosperity and adversity alike, at all times, there is the omnipresent need of holding one's self in hand, of impressing by one's culture and breeding, of *doing the right thing*. Culture is, after all, one of the fine arts. To excel in music or painting, the price is vigilance, study and incessant effort; to be cultured, polished, the price is conscientious effort and study.

"Clothes may make the man," but whether you are clothed in rags or silks your culture cannot be hidden. For he who is polite, refined and well bred wears a gorgeous robe endowed with the fine embroidery of honor and respect. Not even rags can cover it.

The world is a harsh judge, but it is just. It will not tolerate the man who makes blunders at the dinner table. It will not tolerate the woman who breaks the conventions of society at the dance. It will not tolerate the illiterate in the Art of Etiquette.

"Encyclopedia of Etiquette" is excellent in quality, comprehensive in proportions, rich in illustrations. It comes to you as a guide, a revelation toward better etiquette. It dispels lingering doubts, corrects blunders, teaches you the *right thing to do*. It is a book that will last. You will preserve it, to refer again and again to its invaluable aid toward culture and refinement.

New Chapters on Foreign Countries

Two new and interesting chapters have been added to the original edition of the "Encyclopedia of Etiquette." They are "The Etiquette of Travel" and "The Etiquette in Foreign Countries." The woman who is traveling alone must be extremely circumspect in her conduct. The conventions of etiquette must be strictly observed. The man who is escorting a woman abroad must not subject her to embarrassment by blunders in etiquette. Dress, calling cards, correspondence, addressing royalty and addressing clergy abroad are discussed and the dinner etiquette in France, England and Germany is disclosed. The two chapters are brimful of hints and pointers to the man or woman who travels.

SEND NO MONEY

This is the first time that a complete and intensive two-volume set of the "Encyclopedia of Etiquette" has been offered. The edition will go quickly. Don't delay—send for your set NOW before you forget.

The coupon below entitles you to 5 days' FREE examination of the 2-volume set of the "Encyclopedia of Etiquette." At the end of that time, if you decide that you want to keep it, simply send us $3.50 in full payment—and the set is yours. Or, if for any reason you are not satisfied, return it to us and you won't be out a cent. You owe it to yourself and to the children in your home to have a set of the "Encyclopedia of Etiquette" in your library. This opportunity may never come again. Send for the set to-day and surprise your friends with your knowledge of the correct thing to do, say write, and wear at all times. Just mail the coupon — don't send any money. Nelson Doubleday, Inc., Dept. 654, Oyster Bay, New York.

Free Examination Coupon

NELSON DOUBLEDAY, Inc.
Dept. 654, Oyster Bay, New York

Gentlemen:
You may send me the complete two-volume set of the "Encyclopedia of Etiquette." After 5 days I either will return the books or send you $3.50 in full payment. This places me under no obligation.

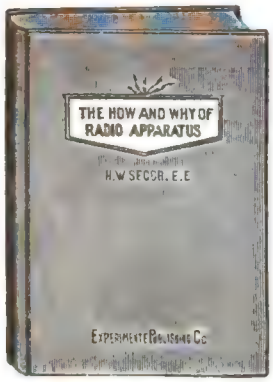
Name .....

Address .....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

SPECIAL PREMIUM OFFER

With a Year's Subscription to "Science and Invention" (Formerly Electrical Experimenter) or "Radio News"



This newest of Radio works, bound in flexible velum and hand sewed, has 160 pages Size of book 6 x 9 inches.

Offer A
"Science and Invention"
for one (1) year with
The How and Why of Radio Apparatus

REG. PRICE $3.00
$1.75
$4.75

Offer C
"Science and Invention"
for one (1) year with
A Thousand and One Formulas

A Laboratory Handbook for the Experimenter. Bound in flexible velum. 160 pages. Size 6 x 9 inches.

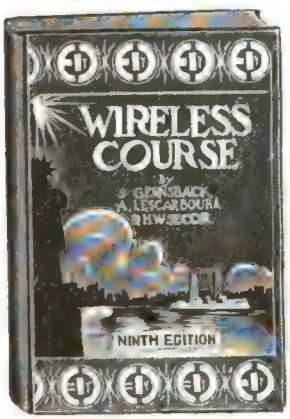
SPECIAL PRICE OFFER, A or C, $3.75

Offer B
"Radio News"
for one (1) year with
The How and Why of Radio Apparatus

REG. PRICE $2.00
$1.75
$3.75

Offer D
"Radio News"
for one (1) year with
A Thousand and One Formulas

SPECIAL PRICE OFFER, B or D, $2.75

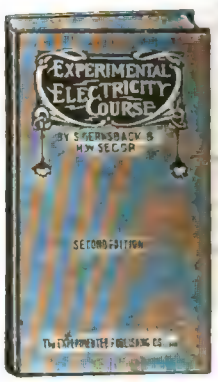


Book is bound in flexible velum; has 160 pages. Size 7 x 12 inches.

Offer E
"Science and Invention"
for one (1) year with
Wireless Course in 20 Lessons

REG. PRICE $3.00
$1.25
$4.25

Offer G
"Science and Invention"
for one (1) year with
Experimental Electricity Course



SPECIAL PRICE OFFER, E or G, $3.50

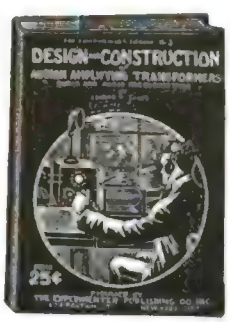
Offer F
"Radio News"
for one (1) year with
Wireless Course in 20 Lessons

REG. PRICE $2.00
$1.25
$3.25

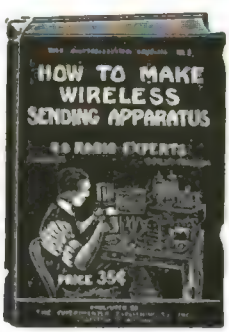
Offer H
"Radio News"
for one (1) year with
Experimental Electricity Course

SPECIAL PRICE OFFER, F or H, $2.50

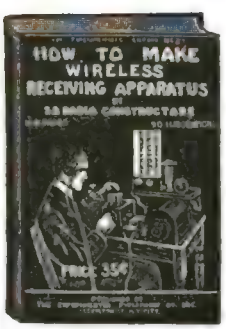
Book is bound in flexible velum; has 160 pp. Size 5x9 in.



Printed on heavy paper, paper bound. Size 5 x 7 inches. Fully illustrated. The latest book out.



Book has 100 pages. Size 5 x 7 inches. 88 illustrations. Paper cover printed in two colors.



Book has 100 pages. Size 5 x 7 inches. 90 illustrations. Paper bound, in two colors.

Offer K
"Science and Invention"
for one (1) year with
Design and Construction of Audion Amplifying-Transformers.
How to Make Wireless Sending Apparatus.
How to Make Wireless Receiving Apparatus.

Reg. Price $3.00
.95
$3.95
Special Price for you **$3.25**

Offer L
"Radio News"
for one (1) year with
Same Books as offer (K)

$2.00
.95
$2.95
$2.25

Bound Volume No. VII
***of* ELECTRICAL EXPERIMENTER**
Price $2.00

This volume comprises the issues of May, 1919, to April, 1920, inclusive. Over 1,300 pages, 2,400 illustrations, and countless articles, diagrams and formulas.

It is a complete cyclopedia of scientific development written in non-technical language. It contains interesting and valuable ideas for many months to come. Attractively bound, stamped in gold. A welcome addition to your library. *Send for your copy today.*

EXPERIMENTER PUPLISHING COMPANY, Inc.
236 Fulton Street, New York City, N. Y.

Gentlemen:
I accept your offer.....Enclosed find $.....
in payment of premium and one year subscription.

Name.....

Address.....

Town.....State.....

S. & I. 3-21

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

NAME	POSITION	SALARY
John	AUTOMOBILE ENGINEER	$125 A WEEK
	REPAIR MAN	$50 A WEEK
	CHAUFFEUR	$30 A WEEK

Put Your Name On This Pay-Roll

Men like you are wanted for big-pay positions in the fascinating field of automobile engineering. We have made it easy for you to fit yourself for one of these positions. You don't have to go to school. You don't have to serve an apprenticeship. Fifteen automobile engineers and specialists have compiled a spare time reading course that will equip you to be an automobile expert without taking any time from your present work.

AUTO BOOKS

6 Volumes Shipped Free

Now ready for you—an up-to-the-minute six-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Brimming over with advanced information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or the owner or prospective owner of a motor car ought to know. Written in simple language that anybody can understand. Tastefully bound in American Morocco, flexible covers, gold stamped, 2,650 pages and 2,300 illustrations, tables and explanatory diagrams. A library that costs thousands of dollars to compile but that comes to you free for 7 days' examination.

Partial List of Contents

- More than 100 Blue Prints of Wiring Diagrams
- Explosion Motors
- Motor Construction and Repair
- Carburetors and Settings
- Valves, Cooling
- Lubrication
- Fly-Wheels
- Clutch
- Transmission
- Final Drive
- Steering Frames
- Tires
- Ignition
- Vulcanizing
- Starting and Lighting Systems
- Shop Kinks
- Commercial Garage Design and Equipment
- Electrics
- Storage Batteries
- Care and Repair of Motorcycles
- Commercial Trucks
- Glossary

Price Reduced!

Down goes the price on these famous Auto Books. We have induced our printers and binders to cut the price they charge us. We pass this saving on to our customers.

Mail Coupon NOW For FREE Trial

Only 10c a Day

Not a cent to pay in advance. First you see the books in your own home or shop. Just mail coupon and pay express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books send only $2.80 in seven days and $3.00 a month until the special introductory price of $24.80 has been paid. (Regular price $45.00.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.00.) This great bargain offer must soon be withdrawn.

SEND NO MONEY NOW

Don't take our word for it. **See the books without cost.** There is so much profit in this offer for you, that we urge you to waste not a moment in sending for the books. **Put the coupon in the mails today. Send no money—Just the coupon!**

Mail The Coupon For These Books

American Technical Society, Dept. A254 Chicago, Ill.

Dept. A254

AMERICAN TECHNICAL SOCIETY
Chicago, Illinois

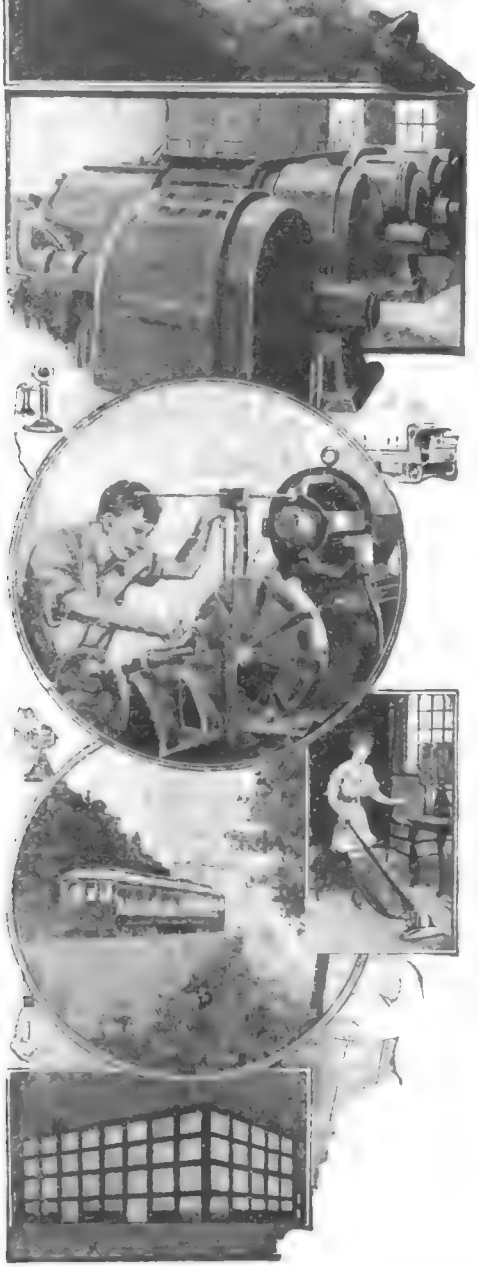
Please send me the 6-volume set, Automobile Engineering, for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2.80 within 7 days and the balance at $3 a month until $24.80 has been paid. Then you send me a receipt showing that the $45.00 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after the seven days' trial I will return them at your expense.

Name .....

Address .....

Reference .....

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing*. That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

The Only Institution of the Kind in America

At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business methods and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

Over 6,500 Graduates are Successful Men in the Electrical World

No previous knowledge of electricity, mechanics or mathematics is necessary to take this electrical course. You can begin the course now and by steady application prepare yourself in a short time. You will be taught by practical electrical experts with actual apparatus, under actual conditions.

The N. Y. E. S. gives a special Automobile Ignition Course as an advanced training for Auto Mechanics, Garage Men and Car Owners. The course covers completely all Systems of Ignition, Starters, Lighting and other electrical equipment on automobiles, motor boats, airplanes, etc.

Let us explain our complete courses to you in person. If you can't call, send now for 64-page book—it's FREE to you.

New York Electrical School

29 West 17th Street, New York

New York Electrical School
29 W. 17th St., New York, N. Y.

Please send FREE and without obligation to me your 64-page book.

..... NAME

..... STREET

..... CITY ..... STATE

Digitized by Google
Original from UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

(*Continued from page* 1364)

Business Opportunities—Continued

Make Foul Proof Spark Plugs. Mechanics out of work. Garage men. Stop oil pumping and fouling. Great opportunity. New idea. Instructions $2. Sample plug $4. Mechanics Supply Co., Gateway Station, Kansas City, Mo.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89th St., New York.

Start a home manufacturing business. Small capital. No equipment needed. I furnish ten selected practical working formulas, typewritten for one dollar. Satisfaction guaranteed. Mynor-Gayle, Box 385, Florence, S. C.

Automatic Auto Top. My latest invention. Get local rights to build and sell same in your locality. Real money maker. Official drawings and certificate mailed you upon receipt of $10.00. Greatest improvement in the Automobile line today. Unequaled features. Address G. A. Stenson, Cokato, Minn., L. Box 132.

Be Independent. We teach by mail how to manufacture unexcelled toilet goods. Particulars free. School of Cosmetics, Box C, Omaha, Neb.

"Money-Talks." The Business magazine published for progressive people. Send for sample copy. P. O. Box 236-B, Newark, New Jersey.

Tattooing is a good paying proposition, start in business for yourself. Complete tattoo outfit for amateurs $10.00. Send 10c for up-to-date price list. Harry V. Lawson, Box 31, Norfolk, Va.

5 Profitable Money-Making Schemes, 20 cents. Address Opportunity, 1820 Oliver St., Baltimore, Md.

Big money made silvering mirrors, auto headlights, refinishing metals. FREE outfits. Write for particulars. N. Decie Laboratories, 286 Fifth Avenue, New York.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $2000 necessary. Will allow expenses to Baltimore as explained. Address, Mr. Clemmer, 603 N. Eutaw St., Baltimore, Md.

Breed Canaries. Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

Money in Mirrors. Guaranteed formula for making and resilvering mirrors 50c. Sheldon Krieger, Metamora, Michigan.

Enter a New Business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by any one at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

Oklahoma Farms. Write for free Agricultural booklet. Board of Commerce, Shawnee, Okla.

Chemistry

Dime Brings You Chemical Formulas, information, construction laboratory apparatus, etc., Evaporating 150 cc. dishes, 4", 40c. Amido Apparatus Company, 3118 14th St., Washington, D. C.

Experimenters! Send now for big value Solubility chart and price list. Postpaid 10c. J. H. Nichols Apparatus Co., 236 Gordon Ave., Syracuse, N. Y.

Chemicals, Chemical Apparatus, Books, Everything for the chemical laboratory. Catalog 5 cents. National Scientific Supply Co., 241 Pennsylvania Avenue, Washington, D. C.

Interesting chemical magazine. Sample copy, dime. Box 134, Swedesboro, N. J.

Radio Active Minerals. Three kinds, 60c. per set. Stamp for our complete list of Chemicals and Chemical Apparatus with prices you will find hard to beat. Enola Scientific Co., 3326 17th Street, Washington, D. C.

Electric Furnaces, Microscopes, Scientific Instruments, chemicals and books are illustrated and described in our new catalogue and handbook—just issued. Over five hundred items listed. Dime brings you a prepaid copy. D. Altman Company, 223-225 East 110th Street, New York.

Chemical Apparatus; Rare Chemicals. Radio-active minerals. Lowest prices. Bulletins for stamp. Enola Scientific Company, 3326 17th St., Washington, D. C.

Bargain. Professional Chemical Laboratory fine equipment $35. The Fair, Paris, Ky.

Astonish Your Friends with the latest chemical novelty. 10 cents coin. P. O. Box No. 73, Station A, Elizabeth, N. J.

Chemistry. Learn Qualitative Analysis by the Modern Simplified Chart Method. U. S. $1.00. Foreign countries $2.00. Technical Charts Dept. C-2, 1038 W. Chicago Ave., Chicago, Ill.

Incorporation

Incorporation in Arizona Completed in One Day. Any capitalization, least cost, greatest advantages. Transact business anywhere. Laws, By-Laws and forms free. Stoddard Incorporating Co., 8-W, Phoenix, Ariz.

Books

How to make Fireworks. 25c. in silver. Columbia Publishing Company, 1345 Park Road, Washington, D. C.

The cause of gravitation, etc.? Treatise disclosing, so the author believes, the true and only consistent theory, 25c. (coin). Wm. G. Conklin, Lawrence, Mich.

Be Manufacturer, make and sell your own goods, 1,000,000 receipts. Selected scientific merchants, manufacturers, business men, grocers, confectioners, medical, technical and practical trade secrets processes for every business. 1016 pages, $2.25. K. R. Skobel Co., 943 Jefferson Ave., Cleveland, Ohio.

Free Book. Elijah Coming Before Jesus. Wonderful. Bible Evidence. Megido Mission, Rochester, New York.

The Amateur Electrician. Pocket size, 20c. (coin). Joel Tillberg, Proctor, Vermont.

300 Book Bargains on Occultism, Mind-reading, Spiritualism, Clairvoyance, Hypnotism, New Thought, Self-Culture, Drugless-Healing, Sex Secrets. Catalog Free. C. E. Winegar, Pub., West Fort Ann, N. Y.

Sex Books for Professional and Advanced Adult Readers only. The Modern Book Society, 5 Hanson Place, Brooklyn, N. Y.

Books and Pictures. Those good kind. "Confessions of a Young Girl," "From the Ball Room to Hell," both good books. Price 50c. each. Sample Art Picture 25c. Send stamp for literature. George Gordon, P. O. Box 1323, San Francisco, Calif.

Perpetual Motion, by Percy Verance. A history of the efforts to discover same from earliest days to the present, together with a scientific discussion regarding the possibility of its ultimate achievement. Profusely illustrated, 357 pages. Price postpaid, $2.00. The Enlightenment Specialty Co., 305 Fourth St., Edwardsville, Ill.

Book Bargains. Mechanical, Electrical, Engineering, many other subjects. Catalogue free. Colonial Book Co., 500 Fifth Ave., 197-A, New York.

Back Issues of this and other magazines supplied by Boston Magazine Exchange, 107 Mountfort St., Boston.

Books on All Subjects. New and second hand. Send for latest mechanical and scientific catalog. The Bargain Book Store, 520 South State Street, Chicago, Illinois.

Value! That's Me All Over! I'm a handy little label book, containing one hundred gummed, attractively printed names of CHEMICALS AND REAGENTS most used in the laboratory. Best little investment you ever made. Neat, convenient. 35 cents (silver) will bring me to your laboratory, prepaid, together with interesting chemical literature. D. Altman Company, 223-225 East 110th Street, New York City.

New Ideas in new book, "The Unfinished Work of the United States." Hidden Facts revealed about its unused seal. For Loyal Americans, $1. Circular free. Neal deVos, Coopersville, Mich.

Safe and Vault Opening Secrets. How to open 22 different makes. How to work out systems to open any Safe or Vault, Combination Setting, etc. Former price $25.00—your copy $5.00 postpaid. J. Hartmann, Desk B, 913 21st Street, Rock Island, Ill.

Free. Upon request I will send you illustrated literature describing the following entitled books; Astrology, Character-Reading, Clairvoyance, Concentration, Entertainment, Healing, Hypnotism, Mechanics, Mesmerism, Mysticism, Occultism, Personal Magnetism, Salesmanship, Success, Seership, Mediumship, Will, Yogi Philosophy, Gazing Crystals, etc. A. W. Martens, J. O. O., Burlington, Ia.

The Web of Destiny, how made and unmade. The Occult Effect of Our Emotions. Prayer—A Magic Invocation,—Practical Methods of Achieving Success. By Max Heindel. 180 Pages Cloth. Two dollars, Postfree. These are the collected fruits of the investigations of a Mystic, explaining the forces which shape our destiny from the invisible planes. This valuable information is given out for the first time in book form. Rosicrucian Fellowship, Box 132, Oceanside, California.

"Ten Days." Stories from Boccaccio's "Decameron"; best you ever read; 35c., postpaid. Martin, Box 67, Pontiac, Mich.

Instruction

Foul Proof Spark Plugs. Make them. New idea. Good money maker. Instructions $2. Mechanics Supply Co., Kansas City, Mo., Gateway Station.

Detectives earn big money. Excellent opportunity. Learn fascinating profession by correspondence. Great demand everywhere. Particulars free. Write, American Detective System, 1968 Broadway, N. Y.

Shorthand Learn complete system, few evenings (home) then acquire speed pleasant practice. Brochure free. Save money, time, increase your efficiency, earnings. King Institute, EO-300, Station F, New York.

Patent Attorneys

Inventors. My clients know every step taken in prosecuting their applications. Booklet sent free on request. Cubberly Kessenich 22, National Union Bldg., Washington, D. C.

Inventors. Before disclosing your invention record it as priority evidence. Personal and efficient patent service by an Engineer and Reg. Patent Lawyer. Maxwell E. Sparrow, 21 Park Row, New York City.

Inventors. Send for form "Evidence of Conception" to be signed and witnessed. Form, Fee Schedule, Information Free. Lancaster and Allwine 242, Ouray Bldg., Washington, D. C.

Patents. Prompt, personal efficient service by an attorney-at-law, skilled in all branches of Patent Practice. Over 12 years actual experience; full information upon request. B. P. Fishburne, 330 McGill Bldg., Washington, D. C.

Monroe Miller, Ouray Building, Washington, D. C., patent attorney, mechanical and electrical expert. Best quality of work and results. Moderate charges.

Patents Procured. Trade Marks Registered —A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 130 Owen Building, Washington, D. C., or 2278-T Woolworth Bldg., New York.

Millions Spent Annually for Ideas! Hundreds now wanted! Patent yours and profit! Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 212 Patent Dept., American Industries, Inc., Washington, D. C.

Patents, trade-mark, copyright, inventors, business men, artists, write. Metzger, Washington.

Patents Secured. Prompt service. Avoid dangerous delays. Send for our "Record of Invention" form and Free Book telling How to Obtain a Patent. Send sketch or model for examination. Preliminary advice without charge. Highest references. Write today. J. L. Jackson & Co., 114 Ouray Bldg., Washington, D. C.

Patents. Send for free booklet. Highest references. Best results. Promptness assured. Send model or drawing for examination and opinion. Watson E. Coleman, patent attorney, 624 F St., Washington, D. C.

Patents. Herbert Jenner, patent attorney and Mechanical Expert, 622 F St., Washington, D. C. I report if patent can be had and its exact cost. Send for circular.

Patents. Send for free book. Contains valuable information for inventors. Send sketch of your invention for Free Opinion of its patentable nature. Prompt service. (Twenty years' experience.) Talbert & Talbert, 4287 Talbert Bldg., Washington, D. C.

"Inventor's Adviser" mailed free on request. Gives complete information relative to patents, trademarks and their cost. William C. Linton, National Union Building, Washington, D. C.

Patents for Sale

Stump Puller, Patent No. 1,298,372; Outright, Sale or Rights to Manufacture on Royalty basis. T. H. Monk, 312 Gaskin Ave., Douglas, Ga.

Patents on following articles for sale outright or royalty. Wonderful manicuring instrument; Secretary or portable writing desk; Beautiful novelty token; New sanitary absorbent pad. Meritorious. Splendid commercial values. Universal demand. Investigate immediately. M. V. Bauer, 2443 Eighteenth St., N. W. Washington, D. C.

Patent for Sale. Outright or royalty. A practical Garden Hose Bracket. Paul W. Heimsoth, Larned, Kansas.

Patent for Sale. Glass Fruit Jar Closure. Issued Dec. 2nd, 1919. Investigate. Edw. C. Ries, 3409 Wyandotte St., Kansas City, Mo.

Personal

Success Lies Within You. Revealed thru personality, Reading by birth date $1.00. Character read by photo $1.00. Valuable suggestions for your future welfare. Orilles, —B International Falls, Minn.

Astrology. Stars tell Life's Story. Send birth date and dime for trial reading. Eddy, 4307 Jefferson, Kansas City, Missouri, Apartment 30.

Photo Developing

Mail Us 20c with any size film for development—and six velvet prints. Or send six negatives any size and 20c, for six prints. Or send 40c for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Co., 255 Bell Ave., Roanoke, Virginia.

Mail Order Business

I made $25,000 with small Mail Order Business home. Sample article 25c. Free Booklet. Stamp. A1 Exp. Scott, Cohoes, N. Y.

(*Continued on page* 1366)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

(Continued from page 1365)

Correspondence Courses

Dollars Saved. All kinds of used correspondence courses sold. (Courses bought.) Lee Mountain, Pisgah, Ala.

Duplicating Devices

"Modern" Duplicator. A business getter; $2.25 up. 50 to 75 copies from pen, pencil, typewriter. No glue or gelatine. 40,000 firms use it. From dealers or on 10 days trial from us. You need one. Write for free booklet. B. J. Durkin, Reeves & Co., Pittsburgh, Pa.

Educational

Free Illustrated Lesson in Advertisement Writing, also Agate Ruler for practice, both mailed you free anywhere, to introduce my New Method. Big demand good writers $3,000 to $10,000 or, do writing home evenings, country or city, selling it far away by mail as I have. I made $100,000.00 recent years. Just your address on postal brings all free, postpaid. C. H. Williams, Department B, Cortlandt Street Building, New York.

Exchange

Let's Swap? Buy. Sell. Whatd'ye got? Whatd'ye want? Dime quarterly. Swap-Bulletin, New York-Detroit.

Bargain. New ¼ Hp., 110 V., 60 C., R. & M. Motor, $23.00; GE., 30 V., 10 A., D. C. Generator (without base), $20.00; Auto Horns, $3.00. Write. Paul Hoffmann, Jackson, Mo.

For Sale. Two large powerful motors, one 12 and one 16 inch. Robinwood Hospital, Robinwood and Delaware Ave., Toledo, Ohio.

Bargain. Regenerative Set with Audion cabinet complete, $35. Apply information E. Schuessler, 2209 Wheeler St., Cincinnati, Ohio.

Sale or Exchange. 1½ H. P. gasoline engine or 3¼" by 3½" air compressor, for ¼ H. P. 25 cycle 110 V. motor, Fisher Ames, Massena Springs, N. Y.

Big Bargains selling Laboratory Equipment. Everything must go. Vibroplex, vest pocket kodak, breast drill, genemotor, etc. Highest bidder. C. Veber, 16 Riverview Street, Walden, N. Y.

For Sale. Army Officers Binoculars, cheap. Box 724, Cincinnati, Ohio.

For Sale. Gundlach Telescope 3¼ inch objective lens. Substantial tripod. Fine instrument $125. E. Prentice, 60 North St., Binghamton, N. Y.

Formulas

1,000,000 Formulas. Processes, Trade Secrets for every business. 1016 pages, $2.25. Ideal Book Shop, 5501-EE North Robey, Chicago.

Earn More! Money making formulas. Send for list and prices. Universal Company, 79 Fourth Ave., New York City.

Formulas—All Kinds. Guaranteed. Catalog 2c. Clover Laboratories, 5501-EC North Robey, Chicago.

3,384 Money-Making Plans. Formulas, Trade-Secrets. "Encyclopedia Business Opportunities." 3 volumes $1.50. Ideal Book Shop, 5501-EV North Robey, Chicago.

Health

Get Big Muscles and Perfect Health. Taught by mail. Wonderful new system. My book "Super-Vitality" showing what it has done for me sent FREE for 4c. postage. Write today. Prof. Magee James, 1127 James Physical Culture Institute, Philadelphia, Pa.

Tobacco, Liquor and Morphine habits have been successfully treated for the past 35 years with Hill's Chloride of Gold Tablets. Why not overcome these Health-destroying Habits? Full information, Literature and Testimonials sent upon request. The Ohio Chemical Works, Dept. 7, Charleston, S. C.

Pyorrhea (Rigg's Disease, Bleeding or Swollen Gums). Hundreds have been helped by "Pyorrdent," the successful home Pyorrhea treatment. Purifying, healing, preventative. Full month's treatment, consisting of a very beneficial massage paste and an antiseptic tooth-cleaning paste to be used in place of your ordinary dentrifice, together with full directions for treatment, $1 postpaid. Or write for free Booklet "E." Pyorrdent Mfg. Co., 439 Seventh St., Brooklyn, N. Y.

Tobacco or Snuff Habit Cured or no pay; $1.00 if cured. Remedy sent on trial. Superba Co., S.A, Baltimore, Md.

Tobacco Habit. Quit easily. Chewing, smoking, snuff cured or no charge. Full remedy on trial. If cured, $1.00. Stops craving; harmless. Perkins Co., M-11, Hastings, Neb.

Reduce weight happily. Improve figure, alertness, health. Lengthen your life. Get Korein tabules, any druggist. Book mailed free. Korein Co., NB-300, Station X, New York.

Free. Stop using tobacco. We will give free information how to conquer habit easily and permanently. Results guaranteed. Anti-Tobacco League, Dept. C, Omaha, Nebr.

For Advertisers

Business is always good when you use Jacobus literature. Letters $3.50. Jacobus Service, 41 Bruen, Irvington, N. J.

For Inventors

Stuck on a Chemical or Electrical Problem? I solve it for five dollars. W. Stedman Richards, Consulting and Research Chemist, 220 Washington Street, Boston, Mass.

Inventors obtain my proposition before filing or disposing of your patent. H. Kaye Martin, 21 Park Row, New York.

Inventors your fortune is made. Address William Hoppie, Montello, Nevada.

900 Mechanical Movements, also illustrations explaining 50 Perpetual Motions. My book, "Inventor's Universal Educator," fifth edition, tells how to procure and sell patents. Government and other costs. Covers the matter from A to Z. 160 pages elegantly bound. Contains noted decisions of U. S. Supreme and State Courts on patent cases. Mechanical Movements greatly assist inventors, suggest new ideas that may prove of great aid in perfecting inventions. Tells how to select an attorney. Has valuable information regarding Patent Sharks, Selling Agents and Brokers. Price $2. Postage free everywhere. Fred G. Dietrich, 603 Ouray Bldg., Washington, D. C.

"Sell or Finance Inventions." Send for free sample copy of Money-Talks Magazine. P. O. Box 236-B, Newark, N. J.

Inventors. Registered Attorney, employed by old established firm, will assist inventors in patent matters at moderate charges. Ralph H. Hoffman, Park Row Building, New York.

Inventors, protect yourselves. Record idea before exposing it to anyone, even myself or other attorneys. Klein Cons. Eng. Reg. Patent Attorney, 21 Park Row, New York.

"Inventors' Guide" free on request; gives valuable advice and information for all inventors. Write Frank Ledermann, Registered Patent Attorney, 17 Park Row, New York.

Inventors write me about patents. My fees payable monthly. Booklet free. Frank Fuller, Washington, D. C.

Get Your Own Patent. $35 complete. Application blanks, forms, and full instructions $1. Theodore A. Cutting, Campbell, Cal.

Become a successful inventor. Instructions $2.00. Inventors' Bulletin Co., Glassport, Pa.

Get Your Patent for $35. Complete instructions $1. R. Matthews, 1050 Camelia St., Berkeley, Calif.

Model making by experts. Satisfaction assured. Scillitoe, 15 Frankfort St., New York City.

Inventions Wanted. Cash or royalty for ideas. Adam Fisher Mfg. Co., 205 St. Louis, Mo.

For the Hair

Dandruff removed quickly, pleasantly, completely. Healthy scalp. For men, women, children. Wonderful benefit. Buy Kotalko at druggist's; or proof box mailed, 10 cents, postpaid. Kotalko Offices, BC-300, Station X, New York.

For Men

Detectives earn big money. Travel. Great demand. Fascinating work. Experience unnecessary. We train you. Particulars free. Write, American Detective System, 1968 Broadway, N. Y.

Send Us Your Dull Safety Razor Blades. We will resharpen them so that they will shave better than new ones for 3 cents each, any kind. Old fashioned razors reground and repaired. Satisfaction guaranteed or money refunded. Send two cent stamps, twenty-five cent books preferred. Keenedge Co., 1 S. Robey St., Chicago, Ill.

For the Photographer

Do You Take Pictures? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 465 Camera House, Boston, Mass.

Miscellaneous

Electrical Tattoo Machines. Tattooing Designs, Colors. Send 10c. for Price List of Tattooing Supplies. Harry Lawson, Box 31, Norfolk, Va.

Luminous Paint: Find any article in the dark. Make your own Luminous Crucifixes, watches, clocks, etc. Bottle 50c. Mission Art Co., 1948 Jay St., Detroit, Mich.

5 Master Keys and novel key chain $1.00. Open and test thousands of different locks. They have satisfied thousands of purchasers, and are used by locksmiths, detectives, travelers, firemen, mechanics. Master Key Co., 57 Manhattan Building, Milwaukee, Wis.

Novelties

Genuine Indian Baskets. Wholesale Catalogue. Marion Gilbams, Highland Springs, Calif.

Mailing Lists

Canadian lists of automobile owners, agents, garages, repairers, dealers, $3 per 1,000. Lasnier Agency, Bathurst, N. B., Canada.

Motion Pictures—Motion Picture Plays

$35 Profit Nightly. Small capital starts you. No experience needed. Our machines are used and endorsed by Government institutions. Catalog free. Atlas Moving Picture Co., 470 Morton Bldg., Chicago, Ill.

Selected Ray Filter Film, beautiful effects, full instructions, enough for four average filters, twenty-five cents, no stamps. L. A. Color Film Co., 700 Exchange Building, Los Angeles, California.

Make $25.00 to $50.00 Nightly. We furnish professional machine, films, supplies, etc., suitable for traveling or stationary use. No experience needed. We teach you this business. Little money required. Easy payments. Large catalogue free. Dept. 610, Monarch Theatre Supply Co., 537 South Dearborn St., Chicago.

Jazz Movie Portraits, patented, $1.50. Machine rights selling. Cenama or Western portraits, 90c. set. Samples and list 25c. Tec-Art, 412 Temple, Los Angeles, Cal.

Electric Moving Picture Machine with one hundred feet standard film $20.00. Catalogue. F. Russell, 102 Englewood Ave., Buffalo, N. Y.

Photoplays Wanted. Big prices paid. You can write them. We show you how. Free particulars. Rex Publishers, Box 175, E-24, Chicago.

Earn $1,200 a year in spare time writing photoplays. Experience unnecessary. Send for free book, valuable information. Special prize offer. Photo Playwright College, Box 278 E-14, Chicago.

Wanted. Men and women ambitious to make money writing Stories and Photoplays. Send for wonderful Free Book that tells how. Authors' Press, Dept. 131, Auburn, N. Y.

Scenery for Hire

Collapsible Scenery and Plush Drops. Amelia Grain, Philadelphia.

Short Stories, Manuscripts Wanted

Short Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 165 Hannibal, Missouri.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Multigraphing

Beautiful Multigraphing on Printed Bond Letterheads. Griffith, C4317 Madison, Chicago.

Musical Instruments

Violins, deep, mellow, soulful, on credit. Easy terms for wonderful instrument. Get details today. Gustav A. Henning, 2424 Gaylord St., Denver, Colo.

Hawaiian Koa Ukuleles with instruction book $10.00 Prepaid. Deroo, 725 Quarry, Honolulu, Hawaii.

Office Devices

Addressographs, Multigraphs, Duplicators, Folders, Sealers. Bought, Sold. Guaranteed Office Device Company, 156-X North La Salle, Chicago.

Old Coins Wanted

We Buy and Sell Old Coins. $2 to $500 each paid. Keep All Old Money; you may have valuable coins. Send 10c. for New Illustrated Coin Value Book, 4 x 6. Guaranteed prices. Get posted. Clarke Coin Co., Box 110, Le Roy, N. Y.

Phonographs

New Type Reproducer. Silk composition diaphragm. Wonderful tone. No scratching. Fits all machines. Plays all records. Fine for needle type records on Edison Machines. Write Mechanics Supply Co., Gateway Station, Kansas City, Mo.

Build Phonographs. Knocked down Cabinets $2. Catalogue, suggestions on cabinet parts, drawings, dimensions, and instructions 65c postpaid. Portland Phonograph Supply Works, 4 N. 15th St., Portland, Ore.

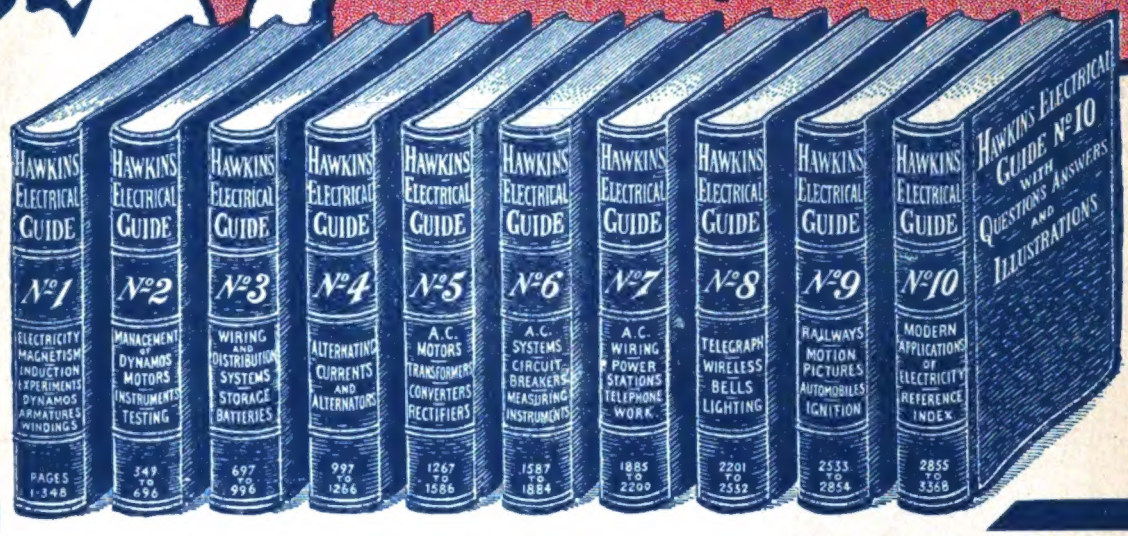
Build a genuine Choraleon Phonograph and save over half. Fine profits building and selling. We furnish motors, tone arms and necessary parts. Send for our catalog and free blueprint offer. Choraleon Phonograph Co., 421 14th St., Elkhart, Ind.

Build Your Phonograph. "Perfection" high quality spring and electric motors, tone arms, reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for 10 cents. Indiana Phonograph Supply Co., Indianapolis, Ind.

(Continued on page 1367)

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Every Electrical Man Wants These Books and we ship them for your inspection FREE


HAWKINS ELECTRICAL GUIDE Nº1 ELECTRICITY MAGNETISM INDUCTION EXPERIMENTS DYNAMOS ARMATURES WINDINGS PAGES 1-348
HAWKINS ELECTRICAL GUIDE Nº2 MANAGEMENT OF DYNAMOS MOTORS INSTRUMENTS TESTING 349 TO 696
HAWKINS ELECTRICAL GUIDE Nº3 WIRING AND DISTRIBUTION SYSTEMS STORAGE BATTERIES 697 TO 996
HAWKINS ELECTRICAL GUIDE Nº4 ALTERNATING CURRENTS AND ALTERNATORS 997 TO 1266
HAWKINS ELECTRICAL GUIDE Nº5 A.C. MOTORS TRANSFORMERS CONVERTERS RECTIFIERS 1267 TO 1586
HAWKINS ELECTRICAL GUIDE Nº6 A.C. SYSTEMS CIRCUIT-BREAKERS MEASURING INSTRUMENTS 1587 TO 1884
HAWKINS ELECTRICAL GUIDE Nº7 A.C. WIRING POWER STATIONS TELEPHONE WORK 1885 TO 2200
HAWKINS ELECTRICAL GUIDE Nº8 TELEGRAPH WIRELESS BELLS LIGHTING 2201 TO 2532
HAWKINS ELECTRICAL GUIDE Nº9 RAILWAYS MOTION PICTURES AUTOMOBILES IGNITION 2533 TO 2854
HAWKINS ELECTRICAL GUIDE Nº10 MODERN APPLICATIONS OF ELECTRICITY REFERENCE INDEX 2855 TO 3368
HAWKINS ELECTRICAL GUIDE Nº10 WITH QUESTIONS ANSWERS AND ILLUSTRATIONS

Flexible Covers — Handy Pocket Size Volumes

10 Volumes — 3500 Pages — 4700 Pictures

$1 Per Volume

$1 Per Month

Just what you need to know to succeed in ELECTRICITY

EVERY electrician, every engineer, every mechanic should know about these wonderfully helpful instructive books, which give in plain words a complete working knowledge of electrical engineering in all its phases.

You run into some new electrical problem almost every day. The information you need to help you in your every day work is in

HAWKINS ELECTRICAL GUIDES

These books place electricity at your finger ends. They cover every imaginable subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—chock full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering. They will help you in every detail of the day's electrical work. You can't ask an electrical question that Hawkins Guides can't answer.

Pocket - Size Flexible Covers

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

SEND NO MONEY

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of, $9 on the easy payment of $1.00 a month till paid for.

Use this coupon to get the books. It will pay you many times over.

THEO. AUDEL & CO.
72 Fifth Ave. New York, N. Y.

SEND NO MONEY - USE THE COUPON

What Electrical Men Say

Helped Him Make Good

"It is only right for me to recommend highly the Hawkins Guides, for they have been of the greatest assistance to me in placing me in my present position as Superintendent of Construction Department of one of Ohio's largest Electrical Companies. I would like to see every man have a set of Hawkins Guides."
Geo. Knecht, Columbus, Ohio.

In the Naval Electrical Dept.

"The Hawkins Guides are great help to me in the Naval Electrical Department, which they cover very thoroughly."
C. J. Cornell.
U. S. Receiving Ship, Brooklyn, N. Y.

Superintendent

"I am now superintendent of the Dunnville Hydro-Electric Systems, and Hawkins Guides were a great help to me in holding down a responsible position."
W. E. Swartz, Dunnville, Ontario.

Wireless Operators

"I have worked wireless for ten years—but I wish I had these books years ago, as they have saved me a good deal of trouble."
H. Marshall,
Steamer M. & B No. 2,
Walkerville, Ont.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamo and motors—galvanometers—standard cells—current measurement — resistance measurement — voltmeters — wattmeters—watt hour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles—alternating current diagrams—the power factor—alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors—induction motors, transformers; losses, construction, connections, tests—converters, rectifiers, etc.

No. 6 Contains 298 pages, 472 illustrations. Alternating current systems—switching devices—circuit breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switchboards, etc.

No. 7 Contains 316 pages, 379 illustrations. Alternating current, wiring power stations—turbines; management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro plating—electro-therapeutic—X-rays, etc.

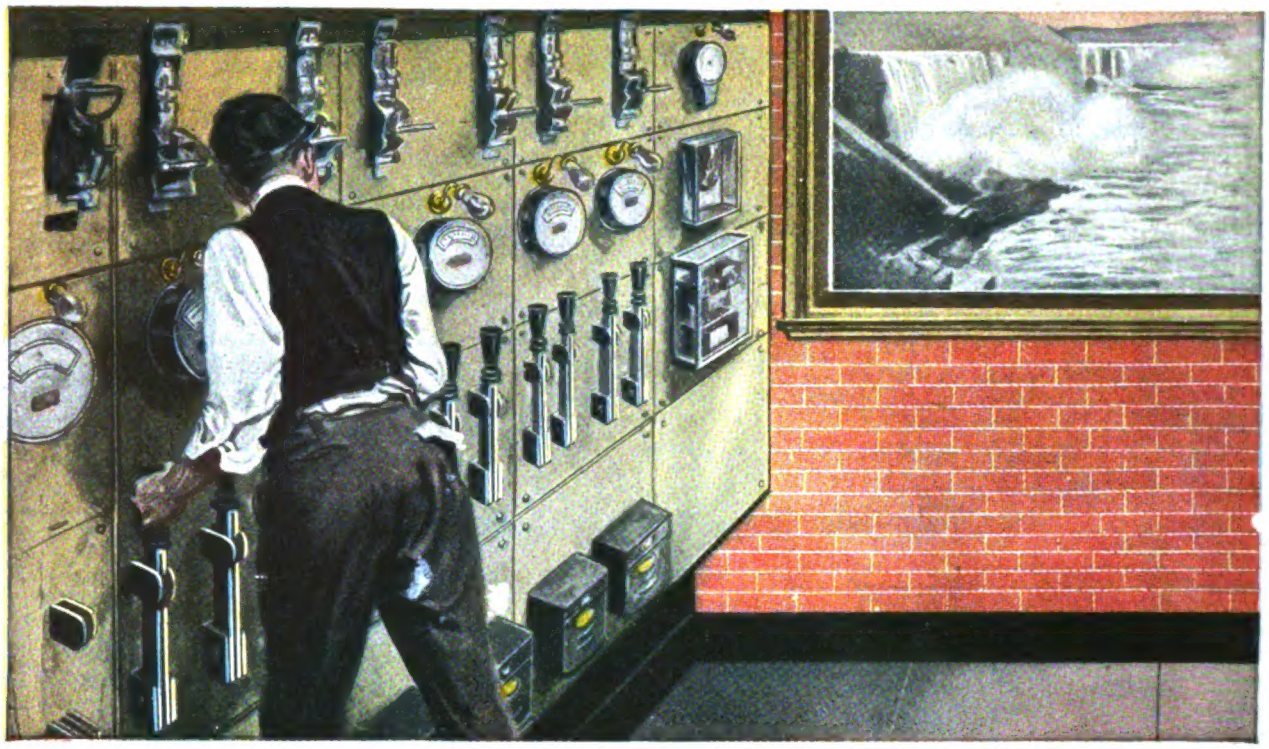
Also a complete 126-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

THEO. AUDEL & CO.
72 Fifth Ave.
New York, N.Y.

Please submit me for examination **Hawkins Electrical Guides** (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature.....
Occupation.....
Employed by.....
Residence.....
Reference..... S. & I. Mar.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



Electricity
Learn At Home

THERE is a wonderful opportunity right now for young men who like electricity. If you are ambitious and will train yourself in spare time you can step into a good position and get experience that will give you a real start toward success in life. Good salaries are offered with rapid promotion.

For 29 years the International Correspondence Schools have been training young men for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of men, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6182-S SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

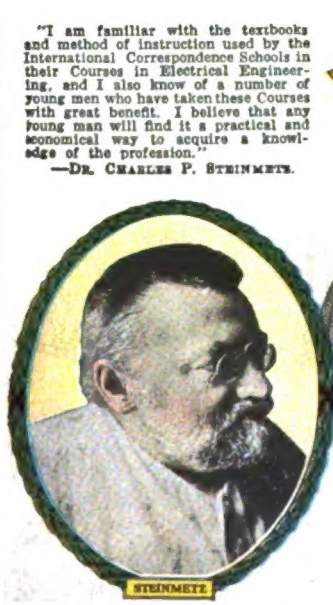
- ☐ ELECTRICAL ENGINEER
- ☐ Electric Lighting and Railways
- ☐ Electric Wiring
- ☐ Telegraph Engineer
- ☐ Telephone Work
- ☐ MECHANICAL ENGINEER
- ☐ Mechanical Draftsman
- ☐ Machine Shop Practice
- ☐ Toolmaker
- ☐ Gas Engine Operating
- ☐ CIVIL ENGINEER
- ☐ Surveying and Mapping
- ☐ MINE FOREMAN OR ENGINEER
- ☐ STATIONARY ENGINEER
- ☐ Marine Engineer
- ☐ Ship Draftsman
- ☐ ARCHITECT
- ☐ Contractor and Builder
- ☐ Architectural Draftsman
- ☐ Concrete Builder
- ☐ S uctural Engineer
- ☐ PLUMBING AND HEATING
- ☐ Sheet Metal Worker
- ☐ Textile Overseer or Supt.
- ☐ CHEMIST
- ☐ Pharmacy
- ☐ SALESMANSHIP
- ☐ ADVERTISING
- ☐ Window Trimmer
- ☐ Show Card and Sign Ptg.
- ☐ Railroad Positions
- ☐ ILLUSTRATING
- ☐ Cartooning
- ☐ BUSINESS MANAGEMENT
- ☐ Private Secretary
- ☐ Business Correspondent
- ☐ BOOKKEEPER
- ☐ Stenographer and Typist
- ☐ Cert. Public Accountant
- ☐ TRAFFIC MANAGER
- ☐ Railway Accountant
- ☐ Commercial Law
- ☐ GOOD ENGLISH
- ☐ Common School Subjects
- ☐ CIVIL SERVICE
- ☐ Railway Mail Clerk
- ☐ AUTOMOBILES
- ☐ Mathematics
- ☐ Navigation
- ☐ AGRICULTURE
- ☐ Poultry Raising
- ☐ Spanish
- ☐ Teacher
- ☐ Banking

Name_____
Present Occupation_____ Business Address_____
Street and No._____
City_____ State_____

Canadians may send this coupon to the International Correspondence Schools Canadian, Ltd., Montreal, Canada

1-1-21

"I am familiar with the textbooks and method of instruction used by the International Correspondence Schools in their Courses in Electrical Engineering, and I also know of a number of young men who have taken these Courses with great benefit. I believe that any young man will find it a practical and economical way to acquire a knowledge of the profession."
—DR. CHARLES P. STEINMETZ.



"I have watched the progress of the International Correspondence Schools. To me their rapid growth is easily understood, because I realize the practical value that is back of them and know something too of the success attained by many ambitious men who have taken their courses.
"May your institution continue to so grow and flourish that the world will come to appreciate the actual worth of the I. C. S. trained men."
—THOMAS A. EDISON.

Digitized by Google
Original from UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN